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RESTRUCTURING OF THE STRATEGIC DEFENSE INITIATIVE [SDI] PROGRAM

JOINT HEARING

BEFORE THE

COMMITTEE ON ARMED SERVICES UNITED STATES SENATE

AND THE

COMMITTEE ON ARMED SERVICES HOUSE OF REPRESENTATIVES

ONE HUNDREDTH CONGRESS

SECOND SESSION

OCTOBER 6, 1988

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RESTRUCTURING OF THE STRATEGIC DEFENSE INITIATIVE (SDI) PROGRAM

THURSDAY, OCTOBER 6, 1988

U.S. CONGRESS,
SENATE COMMITTEE ON ARMED SERVICES AND
HOUSE COMMITTEE ON ARMED SERVICES,
Washington, DC.

The committees met, pursuant to notice, at 9:05 a.m., in room SH-216, Hart Senate Office Building, Senator Sam Nunn (chairman of the Senate Committee on Armed Services) presiding.

Present: Senators Nunn, Levin, Kennedy, Bingaman, Dixon, Glenn, Gore, Wirth, Shelby, Warner, Thurmond, Humphrey, Wilson, Gramm and McCain; Representatives Dickinson, Bennett, Nichols, Byron, Kasich, Ireland, Sisisky, Spratt, Darden, Kyl, Ravenel, Pickett, Lancaster and Evans.

Staff present: From the Senate Committee on Armed Services: Arnold L. Punaro, staff director; Carl M. Smith, staff director for the minority; Marie Fabrizio Dickinson, assistant chief clerk; Gerald K. Bankus, Robert G. Bell, Robert F. Bott, Brian D. Dailey, Colleen M. Getz, Sherri Wasserman Goodman, John J. Hamre, William E. Hoehn, Jr., Ronald P. Kelly, and T. Kirk McConnell, professional staff members; Barbara L. Braucht, Mary J. Kampo, Debra A. Rice, and Mickie Jan Wise, staff assistants.

Also present: Jeffrey B. Subko, assistant to Senator Exon; Gregory J. Weaver, assistant to Senator Levin; William J. Lynn and Christopher E. Paine, assistants to Senator Kennedy; Edward M. McGaffigan, Jr., assistant to Senator Bingaman; Milton D. Beach and Donald A. Mitchell, assistants to Senator Glenn; Leon Fuerth, assistant to Senator Gore; Terrence M. Lynch, assistant to Senator Shelby; James M. Bodner, assistant to Senator Cohen; Mark J. Albrecht, assistant to Senator Wilson; Anthony H. Cordesman, assistant to Senator McCain.

Staff present: From the House Committee on Armed Services: Carl Bayer, Russ Murray, Mary Vesely, Kelly Brown, Sharon Knott, and Andy Ellis.

OPENING STATEMENT OF SENATOR SAM NUNN, CHAIRMAN

Chairman NUNN. The hearing will come to order.

This morning's hearing is a joint hearing of the Senate and House Armed Services Committees to receive testimony on the latest version of the Strategic Defense Initiative's Phase I plans.

I would like to welcome our distinguished colleagues from the House of Representatives. I know that they have a busy schedule

today, and they will be coming in and out, as will some of our Senators who have to be on the floor, in committee, or in conference.

Let me just take a minute to describe the purposes of this hearing.

During the recent negotiations over revisions to the Defense authorization bill, the Secretary of Defense agreed to accelerate the Defense Acquisition Board's review of the SDI Organization's latest architecture and Phase I plans, including their revised plans for the space based interceptor program.

The Secretary further agreed to make the results of the Defense Acquisition Board review and the SDI's new Phase I plans available to our two committees at a hearing prior to adjournment. The Secretary of Defense, offered this, together with his letter assuring us that funding for SDI programs of interest to the committees, which had formally been specified in the vetoed bill, will not be reduced disproportionately to the reduction in SDI's budget request. Those two developments allowed the conferees on the Defense authorization bill to eliminate all the funding restrictions, ceilings and floors, on the SDI program, including lifting the $85 million ceiling on the space based interceptor program, a program that has been the subject of considerable concern here in this committee and I think also on the House side.

Thus, we meet today to receive testimony on both the latest Phase I SBI plans and the recently concluded Defense Acquisition Board review of these plans. I hope that this hearing will prove useful in exploring a number of issues associated with the latest restructuring of the program such as:

First, given what has seemed to be a constantly shifting architecture, how confident can we be that this latest plan won't also undergo significant revisions in the coming months.

Second, to what extent has the Office of the Secretary of Defense and the Joint Chiefs of Staff reviewed the revised plan, and to what extent do they agree with the claims for the restructured program—in other words, independent review? We hope to hear on that from both Mr. Costello and General Herres this morning.

Third, has the restructuring of the Phase I architecture sacrificed capability and, to the extent it has, what capability has been diminished or sacrificed? Also, has the restructuring sacrificed survivability, and to what extent, if that is the case? Have we also increased the risk of failure by the scaling back of the program and the reductions in cost? In other words, what is the nature of the cost reduction and what is the price we are paying in capability, survivability, and also risk of failure?

Fourth, to what extent has the Defense Department included the recommendations of the Defense Science Board SDI Milestone panel, also called the Everett report, in the restructured plan? I hope your testimony will address that.

Fifth, is the administration objectively considering not only the SDI program and the Phase I SBI portion thereof, given the Joint Chiefs' objectives for that program, but also objective and analytical considerations as to alternatives that would, perhaps, achieve the same deterrence objectives that now are the objectives of the SDI program Phase I? I'm talking about a combination of perhaps increased survivability of our own strategic offensive forces, in

terms of land-based missiles, sea-based missiles, and breathing systems, combined with certain arms control goals.

Finally, there is the Nitze criteria, relating to cost effectiveness and survivability. Do those criteria remain the administration's criteria for deployment of this program?

These are some of the issues. Of course, I won't be able to ask questions on all of those this morning. We will each have a limited time and will rotate the questioners. But we will be exploring those issues this morning and in subsequent dialogue and hearings.

Our witnesses are as follows: (1) The Honorable Robert B. Costello, Under Secretary of Defense for Acquisition. Dr. Costello is also the Chairman of the Defense Acquisition Board, which just reviewed the SDI plans on Tuesday; (2) Gen. Robert T. Herres, U.S. Air Force, Vice Chairman of the Joint Chiefs of Staff. The JCS, as we all know, have established the requirements for a Phase I SDI system; (3) Gen. James A. Abrahamson, U.S. Air Force, the Director of the Strategic Defense Initiative Organization, who has appeared before us many times.

We welcome you, Dr. Costello, General Herres, and General Abrahamson.

Before we begin the testimony, let me mention certain procedural matters. We are starting in open session this morning. We hope to continue in open session for the whole hearing. We have reserved the possibility of going into closed session, if necessary, at the conclusion of the open session.

We will stick to the 5-minute rule this morning because we will have a number of members coming in, I am sure, as we go along.

On the Senate side, we will abide by our customary early bird rule.

I don't know whether Mr. Aspin is going to be able to get here, but he has asked that Mr. Spratt stand in his stead. So I will rely on you and Mr. Dickinson to inform me about the order of recognition on the House side.

We can do that as we go along.

That concludes my opening statement. I know Mr. Spratt may want to make a statement, and Mr. Dickinson, on behalf of the Democrats and Republicans on the House Armed Services Committee, and then Senator Gramm would like to be recognized.

Mr. Spratt.

Representative SPRATT. Thank you, Mr. Chairman. I do have a statement that was prepared on behalf of Chairman Aspin, who is not here yet, and as Chairman of the Strategic Defense Initiative panel of the House Armed Services Committee, I will offer his full statement for the record and summarize it.

This hearing represents the final part of an agreement that was reached between the administration and the authorizing committees on the fiscal year 1989 Strategic Defense Initiative program. It is unfortunate that we could not have worked out our situation earlier, but I think the solution agreed upon does provide a sound basis for carrying the SDI program over to the next administration.

I would hope that the witnesses today could provide some specific information on the program.

General Abrahamson, in particular, we—Les's statement said "I," but I think all of us on the committee are speaking here—

would like to take this particular opportunity to thank you for your exemplary service to our country. Your leadership with the SDI program has brought it a long, long way. You have served the country in an outstanding manner. You have always provided us, on our committee, forthright answers. We have not always agreed, but we have certainly had the most civil arrangement, and you could not have been more earnest or forthcoming when we put questions to you or asked you to defend your position.

I would also like, if you could, for you to provide us with your observations as to the future of the program, looking back as you prepare to leave.

But, again, we want to express our sincere appreciation to you for the service you have rendered this program and our country, not just with the SDI program, but with the F-16, the NASA Space Shuttle, and so many other things that you have done during your time as an officer in the U.S. Air Force.

General Herres, we would like to hear from you today in light of the fact that we are in an extreme budget crunch. The projections we have heard about the SDI budget over the next 5 years of $40 billion to $45 billion seem to have some difficulty fitting within the budget projections that we are thinking about also.

One of your predecessors from the JCS, General Jones, testified before the Senate committee last February, and he asked a number of probing questions that we would like for you to address also today. For example, in light of the fact that we are looking at sort of a first phase, or a step system, and if not deployment, then at least going forward with certain elements of this system, we would like to know if the commitment to deploying, or at least pushing the kinetic energy systems may constrain or foreclose the options for the longer term and possibly more promising directed energy systems.

We are interested in what the Joint Chiefs think about the requirements of SDI relative to other requirements, such as conventional buildup.

Thank you all for appearing here today and giving us this opportunity to learn what the plans are for the SDI program for the next several years.

[The prepared statement of Chairman Aspin follows:]

PREPARED STATEMENT OF LES ASPIN, CHAIRMAN, HOUSE ARMED SERVICES COMMITTEE

This hearing represents the final part of an agreement that was reached between the administration and the authorizing committees on the fiscal year 1989 strategic defense program. It is unfortunate that we could have not worked this out earlier, but I think the agreed-to-solution provides a very sound basis for transitioning the SDI program into the next administration. I would hope that the witnesses could provide some very specific information on the program today.

In particular, I would be interested in hearing from General Herres in regards to where the SDI program fits within the other defense priorities. We are certainly in an extreme budget crunch and projections that we've heard in the SDI budget over the next 5 years of $40-$45 billion do not seem to fit with the constrained budget reality. General Herres, I am therefore interested in what the Joint Chiefs of Staff think about the requirement of SDI relative to other requirements such as conventional force buildup and continued strategic force modernization.

General Abrahamson, I'd like to take this opportunity to thank you for the dedicated service that you've given not only to the SDI program but to a number of other programs throughout your career. You have served the country in an extremely outstanding manner. You have always provided the Congress with forth-

right answers on the SDI program and your willingness and ability to make many, many trips to the Hill, not only to the authorization committees, but to many other committees is remarkable. I would like to have you provide us with any observations that you'd like to make as you leave this job. And again, we sincerely appreciate the service that you've extended to the country and I personally look forward to working with you in the future. Thank you.

Chairman NUNN. Thank you, Mr. Spratt.

I will next recognize—is Senator Thurmond here?

Senator GRAMM. He will be back.

Chairman NUNN. Then I would recognize Senator Gramm, and then Mr. Dickinson.

Senator GRAMM. Mr. Chairman, let me thank you for holding this hearing. I have had the great pleasure of looking at many of our SDI projects around the country, and I would like to say that I have been very impressed by what we are doing.

I am not one that is ready to write a blank check for any project that is yet totally unproven, and SDI, like any other program competing for the taxpayers' money, has got to prove itself at every step along the way.

But I am very pleased by what we have achieved. I think we have developed technology that not only can potentially shield America against nuclear attack, but we have generated tremendous technological spinoffs that can be used for conventional purposes. And, as we are all aware, the Israelis, in part using our technology, are on the verge of beginning to build their own missile defense program. I think that is an indication that, not only is there faith with our defense establishment and in the Congress that this system can work, but other nations have that confidence as well.

Mr. Chairman, I would also like to congratulate our colleagues in the Congress, especially Democratic members. I think it would have been easy, since SDI has become somewhat of a campaign issue with Michael Dukakis taking the position that we ought to go back to where we were in missile defense prior to SDI, it would have been easy for many in the Congress, especially Democratic members, to try to have a political test of that basic approach. The Congress has rejected that. We have provided substantial growth by funding SDI on a bipartisan basis, and I think that shows a commitment to a program that is important to the future of America.

So I am delighted to be here, Mr. Chairman, to hear how we are making progress, not just in developing the technology, but in altering the program in such a way as to reduce the costs.

If we can expand technology and reduce cost, we are not only keeping Ivan back from the gate, but we are keeping the wolf back from the door in terms of dealing with the deficit. And when we combine those two, I think we have an ideal program.

Thank you, Mr. Chairman.

Chairman NUNN. Thank you, Senator Gramm.

Congressman Dickinson.

Representative DICKINSON. Thank you, Senator Nunn. I want to thank you and Senator Warner for taking the lead in orchestrating this joint hearing. I cannot remember when we have had a joint hearing between the House and the Senate on the Armed Services Committee before, and I think it is a good beginning.

I would also like to thank our distinguished guests for appearing here today because I know their schedules are just as harried and hectic as are ours.

While I believe that much of what we really need to hear about SBI is better suited for a closed session, I am sure that what we will hear this morning in open session will be very helpful.

All of us are more sensitive than usual to the SBI program in light of recent events, including the President's veto of the Defense authorization bill and the Bush-Dukakis campaigns. However, we are here today to understand recent developments within the Pentagon concerning the SBI program and the President's Phase I strategic defense architecture. Although one would never believe it in listening to all the rhetoric, the House has expressed strong bipartisan support for SBI over the past 2 years.

Last year, our Research and Development Subcommittee, the full committee and the House rejected amendments to cut SBI funding. This year, the full committee rejected another such attempt, and proponents for such an amendment were going to offer it on the floor but, apparently, withdrew it for lack of support.

Many of us who have fought off these members feel vindicated by the favorable resolution of the SBI issue, following the President's veto of the Defense authorization bill. There was no precedent in either the House or the Senate for the cutting of $250 million out of this program.

Before concluding, I would like to take a moment to thank General Abrahamson for his dedication and hard work on behalf of this administration and this program. I am convinced that SDI would not have progressed nearly as far as it has had it not been for the General's tireless effort and attention to detail, his patience—and I would emphasize patience with less knowledgeable Members of Congress.

I think if he had spent the same amount of time on the program as he has in testifying before so many hearings, we might even be further down the road.

Chairman NUNN. He's even been patient with those of us who are knowledgeable on this. [Laughter.]

Representative DICKINSON. General Abe, wherever retirement takes you, I am confident you will continue to excel and continue to succeed. I, for one, would like to offer my personal thanks for your dedication and effort. It has been a pleasure working with you over the years. You are, indeed, a very patient man, very tolerant of us who are less knowledgeable. It has been an education for me just hearing you testify and working with you.

So, good luck and Godspeed, wherever you go.

Thank you, Mr. Chairman.

[The prepared statement of Representative Dickinson follows:]

PREPARED STATEMENT OF MR. DICKINSON, JOINT HOUSE-SENATE HEARING ON SBI

I want to thank Senators Nunn and Warner for taking the lead and orchestrating this joint hearing. I also would like to thank our distinguished witnesses for taking the time to appear before us. While I believe that much of what we really need to hear about the SBI program is better suited for a closed session, I am nevertheless glad to have this opportunity.

All of us are more sensitive than usual to the SBI program in light of recent events, including; the President's veto of the Defense authorization bill and the

Bush-Dukakis campaigns. However, we are here today to understand recent developments within the Pentagon concerning the SBI program and the President's Phase I strategic defense architecture.

Although you would never believe it listening to all of the rhetoric, the House has expressed strong bipartisan support for SBI over the past 2 years. Last year, our R&D Subcommittee, full committee, and the House rejected amendments to cut SBI funding. This year, the full committee rejected another such attempt. Proponents of the amendment were going to offer it on the floor, but apparently withdrew it for lack of support.

Many of us who have fought off these amendments feel vindicated by the favorable resolution of the SBI issue following the President's veto of the Defense authorization bill. There was no precedent in either the House or Senate bills for cutting SBI by $250 million as the vetoed bill did.

Critics of SBI spend much of their time arguing on the political and emotional level. Consequently, we hear a lot about the ABM Treaty or the militarization of space. When these arguments falter, or when their proponents decide to change direction, we are told about the prohibitive costs of SDI in an era of constrained defense budgets and growing deficits. What have too often been presented as credible cost estimates of SDI in the past political dialogue make the national debt look like pocket change. As today's hearing will demonstrate, the costs of SDI are, in fact, in the same range as some on-going programs. If we are to believe recent open source reports, the acquisition cost of 132 B–2 bombers will be higher than that of a multitiered Phase I strategic defense system. Since there is strong bipartisan support for the B–2, a program plagued by rising costs, there is little reason to criticize a phase I strategic defense system because of decreasing costs.

As the centerpiece of the Phase I architecture, SBI itself has been attacked on cost. In fact, the total SBI program will cost only about half of what a 500 warhead Midgetman program would cost if we were to complete it. The point is, we must not let inflated, often politically-motivated cost estimates force us to lose track of what we are trying to accomplish with SDI. Therefore, I hope we are all here with an open mind and I look forward to the testimony ahead.

Before moving on, I would like to take a moment to thank General Abrahamson for his dedication and hard work on behalf of this administration. I am convinced that SDI would not have progressed as far as it has, had it not been for the General's tireless effort, attention to detail, and patience with less knowledgeable Members of Congress. Wherever retirement takes you General, I am confident you will continue to excel, and continue to succeed.

Chairman NUNN. I would like to echo those remarks, General Abrahamson. You have had a remarkable career. This last phase of it is probably going to be judged by history one way or the other in terms of where SDI ends up going. But, nevertheless, I think your stewardship over your whole Air Force career has been outstanding. You have had a tremendous record in a number of development programs. Though there are many different views on this program, certainly your patience and overall willingness, time after time, to explain to this committee and to other committees what you are doing, even when there was serious disagreement, that indeed is appreciated.

We wish you well in your retirement.

Dr. Costello, I think we are ready for you.

Senator WILSON. Mr. Chairman.

Chairman NUNN. Excuse me, but Senator Thurmond has returned.

Senator Thurmond.

Senator THURMOND. I would yield to the distinguished Senator from California.

Chairman NUNN. I would recognize, then, Senator Wilson.

Senator WILSON. Thank you, Mr. Chairman.

I am delighted that we have the opportunity today to acquaint the American public with the enormous progress that has been made on the Strategic Defense Initiative and with the incredible

promise that this program holds for the American security in the near future.

It is hard to believe, Mr. Chairman, that it was only a little over a year ago that this committee took testimony on the then-controversial topic of phased deployments of strategic defense. And yet, today we are reviewing the status of Phase I of the strategic defense system, a system that the Washington Post, in an editorial just this week called a concept that was only a gleam in the President's eye in 1983, now on the way to being realized.

We have made some remarkable progress, Mr. Chairman, and we have done so I think for two important reasons. First, we, in the Congress, have refrained from micromanaging the program, and that was a wise decision. We have determined the broad funding level for a strategic defense and then have left to the program manager the question as to how to allocate those funds among the various technology areas.

Second, as has been pointed out already, this program has benefitted from extraordinary leadership.

I want to take this opportunity to congratulate and to thank, both personally and on behalf of what I hope will be a grateful nation, Lt. Gen. James Abrahamson for not only inspired, but inspirational, stewardship of what is perhaps America's most important defense program.

You, sir, are owed a great debt of gratitude by all of us, by all Americans, but especially from the future generation, whom your efforts will make more secure and who may actually never know the fear that has haunted the last four decades.

So, Mr. Chairman, today we will receive testimony about the first phase of the strategic defense system. It stands at its first milestone, ready to proceed to the necessary development and test phase that will offer the next President and the next Congress the first real choice in the nuclear era.

Chairman NUNN. Senator Wilson, I don't want to cut anyone off, but we usually don't have opening statements except by the ranking member and chairman, and with the House here, if we go with everyone having an opening statement, we will never get to the witnesses this morning.

So perhaps you could summarize it briefly. I have indicated that I will recognize Senator Thurmond. I don't know whether he has yielded to you for this purpose or whether he would like to make a statement. But I can see us going on and on and on this morning and never getting to our testimony.

Senator WILSON. Mr. Chairman, I will complete my comments. I must admit that this is a subject and a panel that inspires me. But I will curb that natural bent.

But it does present us the choice to roll back what has been an ever-escalating offensive nuclear threat, and, instead, to avoid what otherwise would be perpetual and exclusive reliance upon a very precarious balance of nuclear terror.

I think that Americans need to know just how effective, affordable, and near this option is. This is perhaps the best way, Mr. Chairman, to demonstrate that, and for that I thank you for your leadership in calling this hearing.

Chairman NUNN. Thank you, Senator Wilson.

I would recognize Senator Thurmond.

Senator THURMOND. Thank you very much, Mr. Chairman.

I want to join in welcoming our witnessess here this morning and extend my gratitude for their responsiveness to the request of the two Committees on Armed Services for a review of the restructured program.

This hearing should provide an opportunity to explain the considerable technical progress that has been made in the SDI program. Moreover, it should provide an opportunity to discuss the translation of this progress into significantly lower cost estimates that have withstood the scrutiny of independent cost reviews and the Department of Defense acquisition process.

Mr. Chairman, this hearing occurs against a background that I consider to be very positive for the strategic defense program. For one, it occurs in response to an authorization agreement between the Congress and the administration that removed onerous funding restrictions from the conduct of the fiscal year 1989 program.

I believe that sound program management is far better served by the flexibility thus afforded to General Abrahamson and his successor.

Second, I believe that we are at a point in time when even the most skeptical observer will acknowledge that the Strategic Defense Initiative program and the related policy debate over the past 5 years has resulted in a broad consensus that strategic defenses should be included in our strategic equation.

While today's briefing will focus on the changes that have occurred as a result of the recent restructuring of the program in accordance with direction provided by the Secretary of Defense, there is much that has not changed in the program.

First, the JCS requirement for the Phase I architecture has not changed, and the restructured program, while less expensive, is no less effective in satisfying this unchanged requirement.

Second, the space based segment, while reduced in size, complexity and cost, is still an essential element of the Phase I architecture. Moreover, it is the space based element of the program that has brought the Soviets to the arms control negotiating table in a serious fashion and will greatly strengthen the position of our negotiators in achieving a stabilized, strategic relationship.

Third, the restructured program remains as a first step of a phased approach to the vision enunciated by President Reagan 5½ years ago.

Mr. Chairman, I am, frankly, excited about the prospects for the SDI program in the future. I believe that the progress that has been made shows the wisdom of the President's confidence in America's technical prowess. This is America's strength. It is America's strong suit. I believe that our national security has been and will be enhanced by playing to our strong suit.

In closing, Mr. Chairman, I want to take a moment to acknowledge the individual whose name is synonymous with the Strategic Defense Initiative program, General James Abrahamson.

General Abe has been the guiding force at the cutting edge of the most broadly-based technology effort in history.

General Abe has been the superb program manager, challenging his team to reach for performance increases and cost decreases that the skeptics thought impossible.

General Abe has been a man of vision and a skilled and tireless advocate of the President's vision. More important than all of these worldly accomplishment, Mr. Chairman, is the fact that General Abe brought to these accomplishments a deeply human dimension. His quiet strength and determination, his enthusiasm, his ability to weather personal tragedy and professional disappointment and remain the perfect gentleman will long be remembered.

General Abe, I congratulate you on your accomplishments. I thank you for your service. I wish you well and hope that I can always be privileged to call you my friend.

General Abe, I salute you, sir.

Thank you, Mr. Chairman.

Chairman NUNN. Thank you, Mr. Chairman.

Senator Warner is recognized for what he promises will be a very brief comment.

Senator WARNER. Mr. Chairman, here is my opening statement. Please put it into the record.

Chairman NUNN. Without objection.

[The prepared statement of Senator Warner follows:]

PREPARED STATEMENT OF SENATOR JOHN WARNER

SDI AND THE SPACE-BASED INTERCEPTOR PROGRAM

Mr. Chairman, I join you in extending a warm welcome today to Generals Abrahamson, Herres, and Secretary Costello. Your appearance before this joint hearing on the Strategic Defense Initiative or SDI is very much appreciated. I would also like to take this opportunity to thank the distinguished chairman, Senator Nunn, for organizing this important joint hearing, which is intended to provide us with a better understanding of the restructuring of phase one of the SDI program.

This hearing was requested by Congress as part of the agreement that resulted in the resolution of the President's veto of DOD defense authorization bill. I am extremely pleased with the authorization bill, which the President signed last week. I commend my distinguished colleagues, Senator Nunn, Representatives Dickinson and Aspin, and Secretary Carlucci for the tenacious and bipartisan effort that went into the favorable resolution of the DOD defense authorization bill veto. I am particularly pleased by the removal of the so-called "fences" on the SDI program. We all agreed that fences of this sort are a bad precedent and do not facilitate the efficient management of the SDI program or, for that matter, any defense program.

The testimony we receive from the three witnesses today is important. The SDI is at a critical junction. The many technological breakthroughs that have been achieved since the inception of the program is truly impressive. This hearing today is an opportunity to provide the American public with a better understanding of those breakthroughs, and the potential outlook for a defense system to protect the American people from a nuclear attack—accidental or otherwise. The United States has been left totally undefended from even an accidental nuclear armed missile attack for too long.

The deployment of strategic defenses is not necessarily destabilizing as some assert. Indeed, there is no contradiction between deterrence and the deployment of strategic defenses. Historically, a balanced relationship between offensive and defensive military forces has had a stabilizing effect on world affairs; the advent of nuclear weapons has not altered the stabilizing effect of that relationship. I am pleased to see that a consensus is beginning to form on the need to deploy some kind of strategic defense. As the Washington Post recently noted in an editorial: "When he departs the White House, President Reagan will leave behind a broad consensus supporting strategic defense." I agree completely with this assessment, and expect that the need and appreciation for strategic defenses will gain even broader support in the future. The question, of course, is how extensive and for what purposes should defenses be deployed.

The SDI program has also had a positive impact on the arms control process. I believe the SDI program, particularly the SBI component, has been the single most important factor in bringing the Soviets to the negotiating table. This point has been strongly stressed by our negotiators in Geneva. Consequently, my support for the SDI program rests not only on the prospect of deploying a defense to protect the American people and our deterrent forces, but also on the leverage it provides our negotiators in START and the Defense and Space Talks.

Finally, I would like to comment on the recent announcement of General Abrahamson's retirement. When the President announced the SDI over 5 years ago, he challenged the scientific and technical community to use their talents and American technology to explore the feasibility of protecting the United States from nuclear missiles. Such a research effort required a strong leader who was not only a person of integrity but also technically brilliant and a consummate manager. General Abrahamson you have been that kind of leader, and more. You have taken the President's prophetic vision and proven to the American people and world that the United States can meet the challenge. More importantly, you have provided the United States with the opportunity to end the threat of nuclear terror and provide a defense that will do much to promote a stable peace. You are truly a patriot and the country thanks you for the enormous contribution you have made to American national security. I wish you the best and expect that you will once again serve your country—your talents and leadership are needed for the many challenges that face us in the future.

Senator WARNER. I would only say, General Abe, that you carry with you a great deal of knowledge that you gained in office. But America would be more interested to know how you entered into these responsibilities and subjected yourself to crossfire, exceeded only by that received by Dan Quayle, and go out looking younger than when you came in. [Laughter.]

You could make a fortune in the cosmetics field with your secret. [Laughter.]

Chairman NUNN. Hearing no requests for other opening statements, Dr. Costello, grab the microphone and take it away.

STATEMENT OF HON. ROBERT B. COSTELLO, UNDER SECRETARY OF DEFENSE FOR ACQUISITION, DEPARTMENT OF DEFENSE

Dr. COSTELLO. Everybody has his level of patience, and we have also tried General Abrahamson's patience as well in the Department. But he has persevered well.

Members of the Senate and House Armed Services Committees, we really are pleased to have the opportunity to discuss the status of the SDI program and where it stands in the defense acquisition process.

With me today, as you have already recognized, are Gen. Robert Herres, the Vice Chairman of the Joint Chiefs of Staff, and Lt. Gen. James Abrahamson, Director of the Strategic Defense Initiative Organization.

The Strategic Defense Initiative program is a real success story for the defense acquisition process. Our streamlined program management approach has resulted in a highly successful technology development program, which has been thoroughly scrutinized through the Defense Acquisition Board review process. As a result, many positive changes have been made and significant savings are being realized.

As you are aware, major defense acquisition programs must pass through a series of milestone reviews conducted by the Defense Acquisition Board. I chair the Defense Acquisition Board, and General Herres is its very active and participating Vice Chairman.

Following each program review, the DAB makes recommendations to me and, in turn, I make recommendations to the Secretary of Defense.

There are now four milestones through which programs pass as they progress toward production and deployment. Milestone zero, the first, is approval or disapproval of a mission need and an entry into the Concept Exploration-Definition Phase.

Milestone one is approval or disapproval again, to proceed into the Concept Demonstration-Validation Phase in which critical technology and systems issues are resolved through testing and analysis.

In milestone two, the program, again, faces approval-disapproval to enter full-scale development, in which production prototypes are designed and built.

Finally, milestone three gives the program approval to proceed into full-rate production.

The SDI program is unique in acquisition for several reasons. It is the Department of Defense's single largest program, in terms of dollars and the number and types of activities. It is, in fact, a collection of major acquisition programs which, together constitute—and you will hear more about this concept—a "system of systems." It includes a large, longer-term technology program which must be kept in balance with specific elements that could comprise the initial phase of deployment or the Strategic Defense System Phase I.

Finally, SDI did not enter the acquisition process in the usual manner. The program began as a result of President Reagan's unusual vision of a world in which our dependence on and our vulnerability to offensive ballistic missiles could be drastically reduced, or even eliminated, by a shift toward strategic defenses.

As a result, the Strategic Defense Initiative program was initiated in the Department in fiscal year 1985, using a streamlined management approach that you have all recognized this morning.

At that time, it did not fall under the Department's normal acquisition process. As the program progressed, our understanding of how the SDI program could contribute to deterrence evolved. It became evident that certain more mature program elements could be fielded in a first phase. This would begin the transition to thoroughly reliable defenses, while enhancing deterrence.

In February 1987, concepts for a Phase I defense crystallized, and the program was brought into the acquisition process.

The program's first DAB review was conducted by my predecessor in June 1987. At that time, or following the recommendations from the DAB review, the Secretary of Defense approved a milestone zero, based on a mission needs statement provided by the Joint Chiefs of Staff for the entire program, and a milestone one for six elements of the program that could comprise the building blocks for the Strategic Defense System Phase I.

An important part of this review was the development by the JCS of operational requirements that are still the basis for the first phase of deployment.

Another decision at the June 1987 DAB review was that the SDI program should undergo annual DAB program reviews. That is a deviation from usual DAB practices. This was initiated because SDI

is the largest defense R&D program and the administration's highest priority program.

It is centrally managed, but it is executed largely by the military departments. The program is characterized by dynamic management, which as you will see today, has been responding rapidly to technological opportunity.

At the first DAB review, it was clear that change would be the norm for this program. You will see more of it as the program matures.

Finally, as with most large programs, there were a number of uncertainties or concerns raised during the June 1987 DAB review that needed to be addressed further.

We, therefore, concluded that routine annual reviews, not normally milestone reviews, would certainly be beneficial. I chaired our first review in June of this year.

At that review, we came to grips with some difficult issues. First of all, congressional funding was not meeting our expectations. The fiscal year 1988 appropriation was $700 million below our request, and we anticipated similar cuts in fiscal year 1989, based on committee marks.

We were also very concerned about various "fences" being considered by Congress. We would all like to express our appreciation at this point for your removal of those fences. The SDI program will succeed if we are free to apply resources effectively and responsively.

Second, although the program was progressing well technically, our early system acquisition cost projections were too high, and caused the initiation of actions aimed at reducing the development and production costs of high cost components or systems. Meanwhile, the funding program for the SDI program over the 5-Year Defense Plan was not consistent with the planned activities.

As a result of these issues and the Defense Science Board report on the SDI program, Secretary Carlucci provided guidance as to how the program should be modified. I then asked General Abrahamson to respond to these concerns in another review this fall. We conducted this review on Tuesday of this week.

I want to point out that I am describing an iterative acquisition process that is not only working, but is working very well. The DAB analyzed the program and identified problems. The program office took corrective action, and the DAB reviewed and concurred with the results.

First and most importantly among these results is that we have reduced dramatically the cost of the current Strategic Defense System Phase I architecture.

Second, we have balanced the research program within our planned funding. While we will continue to fine tune, our independent OSD Cost Analysis Improvement Group and the services confirm that the estimated costs of the planned research activities are funded within the 5-year defense fiscal guidance.

Finally, the DAB concluded that the SDIO has modified the program in accordance with Secretary Carlucci's guidance. The Secretary's guidance was to continue emphasizing research on space defense; to provide for early deployment of spaced based sensor systems; to maintain the option to develop and deploy a limited pro-

tection system, given a national decision and the funding to do so; and to provide for a balanced, longer-term weapons technology program.

In reaching this decision, the Defense Science Board report was one of a number of inputs considered by the DAB, myself, and the Secretary. The fundamental recommendation of the Defense Science Board was to take a stepped approach to deployment of Phase I, even in the R&D phases as well. The DSB provided an example, but no specific recommendations about what the steps of such an approach might be.

The Secretary has adopted the stepped approach in the guidance I just described. The estimated acquisition cost of the current Phase I architecture was reduced from the original $115 billion to $69 billion. This is truly a startling change and requires explanation.

I would like to point out first that the operational requirements have not changed, nor has the ability of the system to meet those requirements, as Senator Thurmond pointed out. They are the same ones we briefed last spring and that were briefed to you the spring of 1987.

Also, the two-tiered concept, with a space-based interceptor primarily for boost and post-boost phases and a ground-based interceptor for the late mid-course phase of a trajectory, has not changed. What has changed is the distribution of functions within this architecture, as well as the application of technology that we have been pursuing in our technology program.

The largest single cost reduction, from $52 billion to $18 billion, was in the space-based interceptor constellation. Two factors caused this.

First, we were able to increase the performance of each individual space-based interceptor by using more capable seeker technology and design, which the General will talk about later.

This, together with shifting more of the burden to the mid-course interceptor, which increased that inventory by about 70 percent, enabled us to cut the size of the space-based interceptor constellation approximately in half. Over half the space-based interceptor cost reduction is due to this factor.

Removing a number of support functions from the space-based interceptor carrier vehicle, the bus that carries the interceptors, was the other major change. Centralizing the C^3 battle management and fire control functions of the space surveillance and tracking system is also responsible for a decrease in the space-based interceptor constellation costs through a reduction in the vehicle carrier costs as well.

Additional sources of the space-based interceptor cost reduction included changing the manner in which the system responds to defense suppression attacks, as well as the direct impacts of lower cost, more producible interceptor component technologies.

Another major cost reduction is in the space surveillance and tracking system. The diameter of the optical aperture of this system has been reduced by a factor of two. While this is a major driver on the space surveillance and tracking system cost, this reduction also results in its decreased performance capability. The architecture, however, maintains its performance because the other

mid-course optical sensor, the ground-based probe, and the ground-based radar, are now being better utilized to work in conjunction with the space surveillance and tracking system.

Before concluding my remarks, I would like to discuss compliance, which I know is of concern to all of us.

The DAB takes compliance into consideration but does not review programs for compliance. My office, through the Compliance Review Group, is directly responsible for compliance reviews, which are independent of the DAB.

There have been no changes in our position on compliance, which we provided you in testimony last spring.

The SDI research program will be conducted in full accordance with international obligations and domestic law. Defense Acquisition Board (DAB) members are aware that compliance decisions affecting SDI programs are made on a case-by-case basis. We believe that this program is flexibly structured to accommodate future compliance decisions.

After the fiscal year 1990 budget and the annual report to you on the SDI program are submitted, we will be prepared to address these issues in greater detail.

The bottom line is that the DAB review process for the Strategic Defense Initiative has worked very, very well. This is our largest, most complex program, and our acquisition process and policies have been the force behind some very positive changes.

I think General Abrahamson would be the first to agree that the DAB reviews have significantly benefitted the program. The large cost reductions I have discussed are a direct result of that process.

In closing, Congress should realize, as we do, that architectural details will certainly change as the program continues. Cost effectiveness trades will continue. The threat will evolve and technical progress may surprise us in unforeseen ways. The General will touch on that also in his comments.

As these activities occur, I am confident that the acquisition process will continue to serve the Department and the Nation well as we work to develop strategic defenses.

With your permission, Mr. Chairman, I would like to ask General Herres and then General Abrahamson to present their remarks on the SDI program.

[The prepared statement of Dr. Costello follows:]

PREPARED STATEMENT OF DR. COSTELLO

Members of the Senate and House Armed Services Committee, we are pleased to have this opportunity to discuss the status of the SDI program and where it stands in the Defense Acquisition Process. With me today are General Robert Herres, the Vice Chairman of the Joint Chiefs of Staff; and Lieutenant General James Abrahamson, Director of the Strategic Defense Initiative Organization. The Strategic Defense Initiative program is a real success story for the acquisition process. Our streamlined program management approach has resulted in a highly successful technology development program which has been thoroughly scrutinized through the Defense Acquisition Board Review process. As a result, many positive changes have been made and significant savings realized.

As you are aware, major Defense Acquisition programs must pass through a series of milestone reviews conducted by the Defense Acquisition Board. I chair the DAB, and General Herres is its Vice Chairman. Following each program review, the DAB makes recommendations to me, and in turn, I make recommendations to the Secretary of Defense.

There are now four milestones through which programs pass as they progress toward production and development. Milestone zero, the first, is approval or disapproval of a mission need and entry into the concept exploration/definition phase. Milestone one is approval or disapproval to proceed into the concept demonstration/validation phase, in which critical technology and systems issues are resolved through testing and analysis. In milestone two, the program is approved or disapproved to enter full-scale development, in which production prototypes are designed and built. Finally, milestone three is the approval or disapproval to proceed into the full rate production.

The SDI is a unique acquisition case in several respects. It is the Department of Defense's single largest program, in terms of dollars and the number and type of activities. It is in fact a collection of major acquisition programs which together constitute a "system of systems." It includes a large longer-term technology program which must be kept in balance with the specific elements that could comprise the initial phase of deployment or the Strategic Defense System phase one. Finally, SDI did not enter the Acquisition Process in the usual manner.

This program began as a result of President Reagan's vision of a world in which our dependence on and our vulnerability to offensive ballistic missiles could be drastically reduced or even eliminated by a shift toward strategic defenses. As a result, the Strategic Defense Initiative Program was initiated in the Department in fiscal year 1985 using a streamlined management approach. At that time, it did not fall under the Department's normal Acquisition Process. As the program progressed, our understanding evolved of how SDI could contribute to deterrence. It became evident that certain more mature program elements could be fielded in a first phase. This would begin the transition to thoroughly reliable defenses while enhancing deterrence. In February 1987, concepts for a phase one defense crystallized, and the program was brought into the Acquisition Process.

The program's first DAB review was conducted by my predecessor in June 1987. The Secretary of Defense approved a milestone zero based on a mission need statement provided by the JCS for the entire program, and a milestone one for six elements of the program that could comprise the Strategic Defense System phase one. An important part of this review was the development by the JCS of operational requirements that are still a basis for the first phase of deployment.

Another decision at the June 1987 DAB review was that the SDI program should undergo annual DAB program reviews. A deviation from usual DAB practices, this was initiated because the SDI is the largest defense R&D program and the administration's highest priority program. It is centrally managed, but is executed largely by the services. The program is characterized by dynamic management which responds rapidly to technological opportunity. At the first DAB review it was clear that change would be the norm in this program. Finally, as with most large programs, there were a number of uncertainties or concerns that were raised during the June 1987 DAB that needed to be addressed further. We therefore concluded that routine annual reviews, not normally milestone reviews, would be beneficial. I chaired our first review in June 1988.

At that review we came to grips with some difficult issues. First of all, congressional funding was not meeting our expectations. The fiscal year 1988 appropriation was $700 million below our request, and we anticipated similar cuts in fiscal year 1989 based on committee marks. We were also very concerned about the various "fences" being considered by the Congress. I'd like to express my appreciation for your removing those fences. The SDI will succeed if we are free to apply resources effectively and responsively.

Second, although the program was progressing well technically, our early system acquisition cost projects were too high and caused the initiation of actions aimed at reducing the development and production costs of high cost components or systems. Meanwhile, the funding programmed for SDI over the 5-year defense plan was not consistent with the planned activities. As a result of these issues and the Defense Science Board report on SDI, Secretary Carlucci provided guidance as to how the program should be modified. I then asked General Abrahamson to respond to these concerns in another review this fall. We conducted this review on Tuesday.

I want to point out that I am describing an iterative Acquisition Process that is not only working, but working well. The DAB analyzed the program and identified problems; the program office took corrective action; and the DAB reviewed the results.

First and most importantly among these results is that we have reduced dramatically the costs of the current Strategic Defense System phase one architecture. Second, we balanced the research program within our planned funding. While we will continue "fine tuning," our independent OSD cost analysis group and the serv-

ices confirm that the estimated costs of the planned research activities are funded within the 5-year defense plan fiscal guidance. Finally, the DAB concluded that the SDIO has modified the program in accordance with the Secretary's guidance.

Secretary Carlucci's guidance was to continue emphasizing research on space defense; to provide for early deployment of space based sensor systems; to maintain the option to develop and deploy a limited protection system, given a future national decision and the funding to do so; and to provide for a balanced longer-term weapons technology program.

In reaching this decision, the Defense Science Board report was one of a number of inputs considered by the DAB, myself, and the Secretary. The fundamental recommendation of the DSB was to take a "stepped" approach to the deployment of Phase one. The DSB provided one example, but no recommendation, about what the steps of such an approach might be. The Secretary has adopted the stepped approach in the guidance I just described.

The estimated acquisition cost of the current phase one architecture was reduced from the original $115 billion down to $69 billion. This is a startling change and requires explanation. I would like to point out first that the operational requirements have not changed, nor has the ability of the system to meet those requirements. They are the same ones we briefed last spring and the spring before. Also, the two-tiered concept, with a space based interceptor primarily for boost and post boost phases and a ground based interceptor for the late mid-course phase of a trajectory, has not changed. What has changed is the distribution of functions within the architecture, as well as the application of technology.'

The single largest cost reduction, from $52 to $18 billion, was in the spaced based interceptor Constellation. Two factors brought this about. First we were able to increase the performance of each individual space based interceptor by using more capable seeker technology and design. This, together with shifting more of the burden to the mid-course interceptor—which was increased in inventory by about 70 percent—enabled us to cut the size of the space based interceptor Constellation approximately in half. Over half of the space based interceptor cost reduction is due to these factors alone. Removing a number of support functions from the space based interceptor carrier vehicle, the bus that carries the interceptors, was the other major change. Centralizing the C^3/battle management and fire control functions on the space surveillance and tracking system is also responsible for a decrease in the space based interceptor Constellation costs through a reduction in the carrier vehicle costs. Additional sources of the space based interceptor cost reduction include changing the manner in which the system responds to defense suppression attacks as well as the direct impacts of lower cost, more producible interceptor component technologies.

Another major cost reduction is in the space surveillance and tracking system. The diameter of the optical aperture of this system has been reduced by a factor of two. While this is a major driver on the space surveillance and tracking system cost, this reduction also results in its decreased performance capability. The architecture maintains its performance, however, because the other midcourse optical sensor, the ground-based probe, and the ground based radar are now being better utilized to work in conjunction with the space surveillance and tracking system.

Before concluding, I would like to discuss compliance, which I know is of concern to all of us. The DAB takes compliance into consideration, but does not review programs for compliance. My office, through the Compliance Review Group, is directly responsible for compliance reviews which are independent of the DAB. There has been no change in our position on compliance from the one I provided in testimony last spring. The SDI research program will be conducted in accordance with international obligations and domestic law. DAB members are aware that compliance decisions affecting the SDI program are made on a case-by-case basis. We believe that this program is flexibly structured to accommodate future compliance decisions. After the fiscal year 1990 budget and the annual SDI report are submitted, we will be prepared to address this in greater detail.

The bottom line is that the DAB review process for the Strategic Defense Initiative has worked very well. This is our largest, most complex program, and our acquisition process and policies have been the force behind some very positive changes. I think General Abrahamson would be the first to agree that the DAB reviews have significantly benefited the program. The large cost reductions I have discussed are a direct result of that process.

In closing, Congress should recognize, as we do, that architectural details will certainly change as the program continues. Cost-effectiveness trades will continue, the threat will evolve, and technical progress may surprise us in unforeseen ways. As

these activities occur, I am confident that the Acquisition Process will continue to serve the Department and the Nation well as we work to develop strategic defenses.

With your permission, Mr. Chairman, I would now like to ask General Herres, and then Lieutenant General Abrahamson, to present their remarks on the SDI program.

Chairman NUNN. Thank you.

General Herres.

STATEMENT OF GEN. ROBERT T. HERRES, USAF, VICE CHAIRMAN, JOINT CHIEFS OF STAFF

General HERRES. Mr. Chairman, I would like to add just a few thoughts to the comments that Dr. Costello has presented in his statement.

Fundamental to the acquisition process that he described is the development of the system requirements. These requirements are the yardstick which measure the adequacy of the system concept definition. Much of the discussion this morning I am sure will center on the system concept definition.

Operational concepts and requirements are the responsibility of the Chairman, with the advice and the counsel of the JCS. I can assure you that, as a corporate entity, the JCS has been very much involved in addressing the SDI effort.

Because these two documents play such a critical role, there are five important features of the SDI mission need statement and its Phase I requirement, upon which I would like to comment.

The first refers to deterrence, the first fundamental feature.

Both the mission need statement and the Phase I requirement are rooted in the basic concept of deterrence. The system will have military utility if it makes the likelihood of nuclear war diminish.

The Phase I performance has been established at a level which, in our judgment, provides the minimum capability required to begin making a contribution to deterrence of Soviet strategic nuclear attack. We think of them, the Phase I requirements, that is, as a threshold beyond which a strategic defense system becomes a factor in the nuclear deterrence process.

Now, there are other spinoffs of this requirement, and I am sure you will want to discuss some of those, which of course, is a limited protection system, protection against accidental launch, and protection against other kinds of threats. But the fundamental approach that we have taken in defining the goals and objectives, and the operational usefulness of this system, is deterrence of Soviet nuclear attack.

Phase I is not an objective system. It must be regarded as the first militarily useful step toward an objective system. This is not to say, however, that an incremental approach to achieving the desired Phase I capabilities is inconsistent with the requirement; but, rather, that one should not expect a militarily significant contribution to deterrence until the Phase I requirement can be met.

Calls for survivability are in both the mission need statement and in the Phase I requirement—survivability to a degree that assures that the mission can be accomplished.

The requirements encourage the use of highly leveraged space-based system elements. This, of course, indirectly suggests a lay-

ered system, and the calls for survivability in the requirements also suggest the utility and the desirability of a layered system.

But, above all, the requirements are intended to provide the developer with a maximum amount of flexibility and, at the same time, sufficiently channel the efforts of the developer toward the goals I have discussed. In other words, the requirements do not preordain a system design concept. They are performance and goal oriented.

The mission need statement, which is the first of these two basic requirements documents, has been, and will continue to be, our principal guideline as we develop follow-on requirements for increments of the system beyond the Phase I deployment and move toward an objective system. The mission need statement provides a broad framework for the overall strategic defense system in the aggregate.

The revised system concept, which was presented to the DAB by the SDIO, meets the Phase I performance requirement. There are tough development challenges which lie ahead. Dr. Costello has already referred to them and we are not oblivious to that fact.

Although we have yet to update our threat model by transposing it to a new deployment projection date, our expectation is that the concept proposed can do the job that we have laid out for it.

The result of all of this will bring us a defensive ingredient to our strategic force structure and, thus, balance today's offensive capabilities with this vital new dimension.

I know there is concern, and the question has really already been asked in the opening remarks, about how we feel about the money, the dollars, that the SDI will claim within the Defense budget. Let me just amplify what I have said about what we call for in the requirements with a couple of thoughts.

The JCS are committed to a balanced strategic force structure, and that commitment is manifested in the mission need statement. This has not been possible in the past. To have done so in the past would have been to force the advancement of technologies at costs we could not afford.

The work that has been done over the past 5 years, however, provides us now an opportunity to exploit mature technologies and some still maturing, and to introduce ballistic missile defense capabilities into our strategic deterrence force structure.

As you know, I don't need to tell this audience, the strategic defense capabilities that exist in our force structure today are very, very insignificant, compared to the threat.

We would like to see all systems cost less, considerably less, of course, than what we are talking about for this Phase I system. But there are a lot of other systems that cost a lot of money. There are a lot of other systems that are substantial, technological challenges. They all require the difficult choices that have to be made when it comes time to prioritize.

The SDI cost projections are not immune to our concern. We have expressed that concern to the Secretary at some length, when we saw the big bite that the original Phase I concept would take out of the strategic budget. It seemed disproportionate to us.

The concept has since been reviewed. It has been revised. It has been reviewed again, as Dr. Costello has explained.

The cost goals that General Abrahamson has outlined for his Phase I system concept are going to have an impact on our overall budget and on our strategic defense budget, as would any new major system in that segment of our budget.

But if we choose our options carefully, as each one presents itself, these cost goals should be manageable in the context of what it is we are trying to achieve.

Now I would like to turn over the podium to General Abrahamson, who will tell you about the revised Phase I concept.

Chairman NUNN. Thank you.

General Abrahamson.

STATEMENT OF LT. GEN. JAMES A. ABRAHAMSON, USAF, DIRECTOR, STRATEGIC DEFENSE INITIATIVE ORGANIZATION

General ABRAHAMSON. First of all, since this may be my last time talking to each of you, I would like to really thank you, not only for your kind remarks but also for your overall contribution to the country. Perhaps the best way that I can express my feelings is in the last paragraph of my letter to the Secretary of Defense in July. I won't quote the whole letter, but just the last paragraph.

"In particular, I wish to thank you"—that was Secretary Carlucci—"Mr. Weinberger, the President, and the many people in DOD, industry and Congress, both supporters and critics, who have allowed me to assist in this worthwhile endeavor."

"I will continue to dedicate myself to SDI to my last day of active duty and after. Further, I have great confidence that this initiative will go forward and will succeed."

I wish that every citizen of the United States had the opportunity that I have had, particularly in this program, to see the way our Government works. This has been an open program. That was a proper decision by the President of the United States and by the Secretary of Defense.

It has been incredibly controversial. You have thanked me for taking the time to talk to you all and to try to present this program. But I have to thank you because of the efforts you have made to try to understand, to deal with, and to apply your wisdom to such a difficult endeavor.

This particular experience for me, to see exactly both how an executive branch and a congressional branch can work, proper checks and balances, proper probing, proper challenges to everybody, has been an experience that I believe would be the most valuable contribution to every citizen if they understand it because, very often, people lose perspective, they see the problems and, in fact, the press, often by focusing on the problems, presents a cynical view of what is going on.

I don't believe that is what is going on. I think things are going right, to a very, very large extent, and, in fact, it is because of the dedicated efforts of all of you in doing jobs that I think are nearly impossible.

The expertise that you have to, in fact, bring to such a broad range of issues, the demands on your time, are something for which, as a taxpayer and as a citizen, I have to thank you. And as somebody who has had to work with you because it is my job, but

also who has had the privilege of working with all of you, I want to thank you as well.

Now, there has been a lot of conjecture about why I am leaving at this time. Frankly, I find that both amusing and distressing. I would like to try to use this moment, on the record, at least, to try to set that as straight as I can.

First of all, it has been 33 years of public service, and I have been proud of it and happy that I have had the chance to work with all of the people that I have.

But, from a program point of view, we are at a threshold, and, no matter who is elected, both in a new administration or Members of Congress, the program will continue to be examined very carefully. I want to be in a position to make recommendations, recommendations that I am thinking about now and which I am not prepared to make at this point, but recommendations about the best way to proceed to build on the progress that we have made, but recommendations not at the level of funding and the issues that people have conjectured about, but at the level of organization, and the level of control, and the level of how we can best build on the incredible progress that people have made, and not have people misinterpret that I am fighting either for my job or to improve that job.

I really want to ensure that the program is on the best footing possible.

So that is my motivation. People have conjectured that I have been disappointed. I have been disappointed in the level of funding, that is correct. I have been disappointed in terms of the fact that we have not gotten from the Congress, as they look at their broad requirements and the many priorities we have, the level that we think we need. But, at the same time, I have to thank you because each year, although it is very small this year, each year you have allowed us to grow and to structure a program that, in the judgment of the experts and the people around this country who are making it happen, would be the optimum.

In that sense, your action in coming to an agreement to open up the program to allow us to continue what I think was a major, major step for us, and I hope that you will allow that same kind of freedom and judgment to my successors in the future. I believe you will.

Now I would like to make one further important recommendation.

It has been both in open and closed hearings and in individual opportunities to work with all of you a very special thing for me to be able to talk about the program. Very often, the program, the discussions, and the testimony, as it will be today, are focused on the technical progress of this amazing technical adventure. However, the remarkable speech and the vision that the President laid out for us in 1983 went well beyond that dimension of just technology.

It really went to the fundamentals of nuclear strategy and the best way to secure this Nation in an uncertain future. In fact, his challenge is being met not only technically, but in other ways as well.

If you look over on this table (indicating), you will see on the right-hand side examples of technology. I will try to explain some of those.

But on the left-hand side, you see books, papers, thoughtful efforts. I know that you have participated in some of those, and I have participated with you in discussions of that.

It is really the emphasis on strategy that has been the real benefactor of the President's remarkable speech. This is only a small sample because we have reopened what had been a closed discussion of the best way to ensure security in the nuclear age.

I believe and I would recommend that that is a proper subject for public hearings. Not only the technology—obviously you must, and you have a responsibility to deal with the technology and how we are spending the money—but you and I have participated in thoughtful discussions on strategy. I think it is important that that be available in open testimony to the Nation.

That, at least, is one recommendation that I would offer for my successor and all of you.

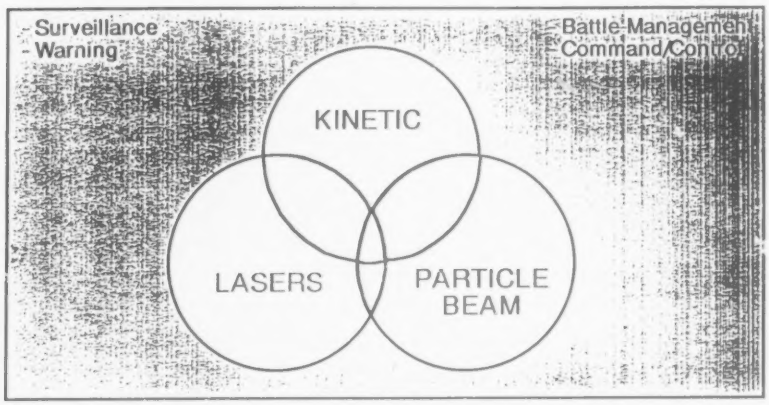
With that, finally, I would like to turn to a short briefing and the subject, the primary subject of this hearing, and that is the progress that we have made and, in particular, the space based interceptor and how it fits into the context of the overall program.

Now, what I am doing is I am representing the progress of thousands and thousands of people and the efforts that they have made. I, in particular, would like to thank them because that has been, perhaps, the most satisfying to me as a technical manager and as an engineer, because it has been amazing.

If we could, let's start with the slides, please.

LONG TERM ARCHITECTURE

- Enduring Surveillance, Warning, Battle-Management And Command/Control Infrastructure
- Triad-Like, Mutually Reinforcing Strategic Defense Weapon Structure



The first and most important thing that has often been misunderstood is how does Phase I work in the context of a total architecture and the requirement that General Herres outlined for the long-term goal that the President outlined for us—a thoroughly reliable system.

Well, Phase I is the first step. It is deliberately limited in its capability because we don't want to over-invest in that first step. We want to create something, and the best way that I can describe it is analogous to the triad in the offensive deterrent.

Now, my view of that—and I will develop that further in the last few months that I am here—is that, first of all, you must put into place the battle management to control the surveillance, the warning, all of those systems which will not be only for Phase I, but, in fact, will endure and be the foundation of the follow-on steps as well.

That is one of the reasons Phase I is so expensive. Over half the costs in our current projection are associated with that. And that is not Phase I-peculiar. That is for everything. It goes beyond that.

If you look over to your right, at the Phase I architecture, there are several satellite systems, surveillance systems, a high altitude satellite called BSTS—you know that one; that's our warning satellite—a lower altitude one called the surveillance SSTS, augmented by a ground probe, to give it survivability, and even now augmented by radar, in order to give us the opportunity to look throughout the entire area of the spectrum at what is coming, so that you can do that job.

All of those are expensive and they are not limited only to Phase I.

In fact, less than half the costs are associated with the interceptors, the weapons in Phase I that are aimed at destroying ballistic missiles.

So, when one makes this comparison of the costs of this kind of capability, and makes a comparison with other systems, our offensive deterrent systems, remember that even our offensive deterrent systems will come to pass and be in the context of other warning systems, of other command and control systems. So, therefore, you should not compare only the cost of Phase I to Midgetman, for example. A fairer comparison would be the cost of a Midgetman and its contribution to deterrence and the weapons in this kind of eventual defensive deterrent addition.

Now, the weapons will come in stages. The first one is the kinetic stage. That is like one leg of the triad. What that means is we will only go part-way, far enough to meet the requirement that was set out by the Joint Chiefs of Staff. But we don't want to over-invest because coming behind it and coming along rapidly are such things as lasers, which will have entirely different characteristics, entirely different problems for the Soviets to overcome, and, in fact, joint ways in which they can work together with the kinetic systems to make the system an even more powerful deterrent.

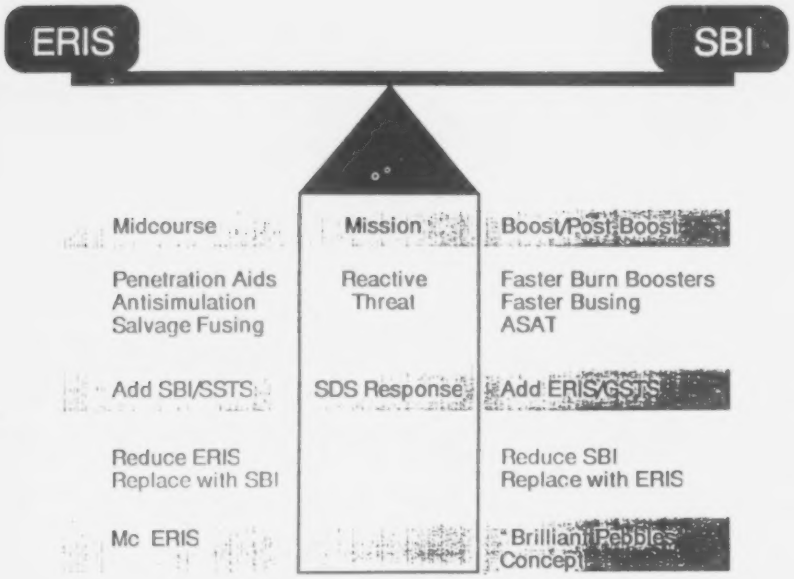
It is not only the lasers that are coming. It is also such other new and advance concepts as particle beams.

So, if you think of a long-term system and you need an analogy, think of the triad and the way that elements of the triad work together and the fact that the weapons in this enduring system will, in fact, have very different characteristics and will be kinetic, will probably be lasers and will probably be particle beams.

Even if we were to wait for the lasers or the particle beams, we would still want a kinetic system because of the problems that that will present to the Soviet war planner. Remember, that is our objective. We want the Soviet war planner to be so convinced that he can never achieve his objective so that he will never strike, even under the worst of crisis conditions.

Next slide, please.

PHASE ONE INTERCEPTOR RESILIENCY



The weapon architecture is divided between space-based and ground-based. I have shown that in this chart as a balance, a balance between two of these, and the mission of each is different.

The space-based interceptor's mission is to be right over the Soviet Union, or a missile that might be fired anywhere else on Earth, and to stop it as soon as possible, and to offer the first of a layered defense. You know that and understand that.

The ground-based systems cannot reach over to that position. There is no way that they can reach that far. Therefore, they have a different kind of contribution to the layered defense, and they are really for the mid-course, a very different kind of job.

But the balance between the two offers us a resillent architecture that will continue to change. For example, if the Soviets decide that, in order to counter space-based interceptors they want to build faster missiles, or they want to employ more ASATS, perhaps even very devastating, nuclear ASATS, then a future decision can be made as we see them begin to test these systems to compensate either by adding more SBIs or perhaps by adding more ground-based ERISs.

If, on the other hand, we only had the ground-based segment and we were only going to operate in the mid-course section, then they would concentrate on penetration aids. They may even salvage fuse, which means that each time a warhead is intercepted, it would explode and there would be a nuclear explosion, causing a great deal of chaos and confusion.

There are other techniques they might use.

By having this kind of development program going forward, as we see that in test, we can add more space-based interceptors, where that would be negated. That is the strength of the fundamental architecture.

There are responses; but there are also growth paths in both of these directions. I will show and comment on one.

You asked, will this change in the future? The answer is yes, as technology progresses. It won't change in a fundamental way, but it will improve and, I hope, be more affordable. Because we have both the space-based interceptor and other kinds of concepts such as "Brilliant Pebbles" that you have heard about, which hopefully, will be less expensive and that we are pursuing to bring down the cost. For the ERIS type of missile, there are lower cost versions that the Army team has put together that are equally promising.

So, there is a balance and a growth path to bring down the costs even further.

May I have the next slide, please.

MAJOR ACQUISITION COST REDUCTION

SBI (66%)
- Remove CV Fire Control Sensor
- Remove CV BM/C^3 Functions
- Change IV Focal Plane Array/Processor
- Reduce Quantity

SSTS (27%)
- Reduce Aperture
- Reduce FPA Detectors/Processing
- Increase Quantity

BM/C^3 (50%)
- Deletion of Airborne Command Center
- Lease vs. Purchase of Fiber Optic Network
- Software Definition/Maintenance

SE&I (36%)
- Transfer of BM/C^3 Requirements
- Elimination of Redundant Requirements (Training, etc.)
- Change in Percentage of Government Costs

Here are some of the elements of why these costs came down. This is a cost projection. You should not consider this the price tag for the future system. This is a tool that we use as part of the acquisition process that Dr. Costello described, to help us manage the program more effectively and to concentrate on the things that are opportunities to bring the costs down in the future.

So, it is not the price tag; it is a tool for me and should be a tool for you because you can see where we are as we go forward.

Chairman NUNN. General, could I clarify that, if you don't mind?

General ABRAHAMSON. Yes, sir.

Chairman NUNN. As I understand it, what you are saying is this is a cost goal rather than a cost projection?

General ABRAHAMSON. No, sir.

It is a carefully studied and independently evaluated cost projection. But the way I use that in the program is it identifies where there are opportunities for future cost reductions, and then, because you have now allowed us and have in the past allowed us the opportunity to shift money and shift resources to try to find ways to bring those parts of the program even to lower cost levels and more affordable levels, then, in turn, that will, when that technology matures, when we have proven it, allow the cost projection to come down even further. But it is not a cost goal. We set cost goals.

Chairman NUNN. Then I misunderstood you.

Dr. Costello.

Dr. COSTELLO. If I might, Senator, the number the General is using today went through the same cost scrub with the same criteria that the previous numbers had gone through. They are a specific, we'll say, "cost projection" at this point. But I think the General wants to make sure that there are still opportunities for continued improvement in those numbers——

General ABRAHAMSON. Absolutely.

Dr. COSTELLO [continuing]. That the $115 billion we started with went through the standard, independent analysis and scrub. The new numbers went though the same people, that same scrub—the $69 billion about which we are talking. I think the General wants to ensure, we all want to ensure, that we understand there are still further reductions the General will discuss that may come into fruition.

Chairman NUNN. Is that both ways? Can it go up or down, or is it only downward? Can we be sitting here told that this is a ceiling and everything is going to be better from now on in terms of cost projections? You're saying that the same people who gave us three times this estimate in the spring have now reduced it by 300 percent.

I'm not sure that that is comforting in terms of whether this is a goal or a projection.

Dr. COSTELLO. They have been working on those not since last spring; they have been working on it for over 1½ years, in getting these new numbers. Under our guidance, our direction, the Secretary's direction, in conformance with the Joint Chiefs mission requirement, those numbers have to continue to go down.

Chairman NUNN. But you're saying that this is a projection, not a goal?

General ABRAHAMSON. I'll show you a separate set of goals.

Chairman NUNN. Could I get Dr. Costello to say—he seems to be a little reluctant here.

Dr. COSTELLO. I want to know the semantics. This isn't a mythical goal that we would like to achieve. This is a projection, based on the data we have at hand today.

Chairman NUNN. Is there another word for when it gets firmer?

Dr. COSTELLO. Yes. That will be after we have paid the bill. [Laughter.]

I want to make you more comfortable here. These are the numbers we have put in our projection for the 5-year forecast. These are the numbers we have to live with, the first part of the numbers that we are talking about; so that we have available the numbers and the monies with what we think are going to have to be approved by Congress. So, it is a realistic set of numbers with which we are dealing.

Representative SPRATT. For the record, could we simply clarify who did this cost derivation? Was it done by SDIO?

Dr. COSTELLO. No.

General ABRAHAMSON. No.

Representative SPRATT. Was it scrubbed by OSD? Exactly who did it?

Dr. COSTELLO. It was independently reviewed by the Office of Program Analysis and Evaluation's Cost Analysis Improvement Group.

Representative SPRATT. Was there any input from contractors?

General ABRAHAMSON. Sir, the methodology for these kinds of cost activities in the Department is well-established methodology. There are models that are based on experience, that are generated independently from the contractors.

The contractor involvement is obviously to be able to show that the technology is there to relate to the cost models as they go ahead.

These are models that were used in other cost estimates and other systems. They are not only for SDI.

Part of the challenge for us, however, is that we are moving forward into new levels of technology which the cost models do not represent very well. Therefore, the consistency of the application of these cost models and the methodology is a very important element, and it was, in fact, consistent with one that was presented last spring, the same consistent methodology that was applied here.

But the fact that the cost numbers have come down are due to real changes and real technology progress.

Now, if we are provided the opportunity to carry out the plans that are on the books and the investment in the kind of research that I will show you, I believe that these numbers will not only become a reality, but we will have opportunities to bring it down even further, toward cost goals that are being set on the program.

So there is a difference between the cost projections and the cost goal.

The reason I wanted to emphasize that it is part of a process is it is a responsible process in the Department that allows us to always have an annual update to our best cost projection for the future.

Chairman NUNN. I guess we would have to be pardoned if we expressed some skepticism on the cost, based not just on this program but on others. Every time we get into the selling stage, the charts go down. When we get into the building stage, the costs go up.

So, Dr. Costello, your remark that we will really know when we start paying for it and pay the bills is probably the best summary that I have heard.

Dr. COSTELLO. I will reiterate. The costs of the new architecture reflect the responsibility of the military departments to perform

cost analysis with their budget submissions against the technical requirement. We started off with military departments as an independent review. They provided that review to the Office of Program Analysis and Evaluation and it went through the overall scrub in the process. So it has been a rigorous review.

Chairman NUNN. Good. Thank you.

Go ahead, General.

General ABRAHAMSON. Here are areas, and I won't go into all of the detail, but those are specific changes that either represent research that has come to fruition sufficiently so that we have confidence in it and, therefore, can use it properly in the cost projection, or changes that will increase performance, that allow us then to change such things as removing from the carrier vehicle the fire control sensor.

The most important thing that has happened which allows us to do that and to do it with confidence is the progress of the focal plane array. I will comment on that a little bit later.

But you will see that there are changes in each element of the system very carefully arranged for, very carefully examined. And, in fact, as we go forward in this demonstration and validation phase of the research program, you will get higher confidence in these cost projections, so that when it comes to making a decision about going ahead at milestone two for the development phase of the program, hopefully you will, in fact, have the real basis to go forward at low risk, low cost risk and low technical risk.

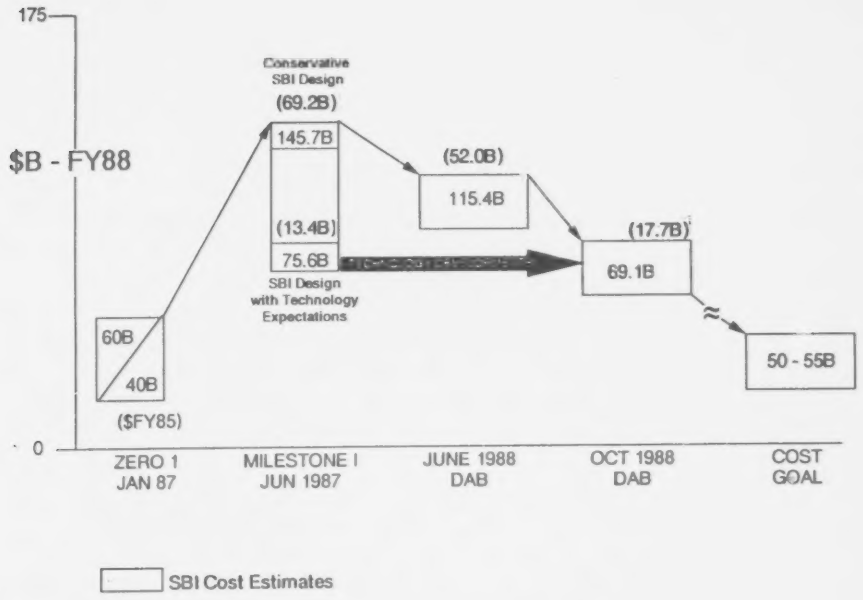
I would like to observe that maybe for a lot of different reasons, we are probably doing this program closer to what has been recommended as the ideal, certainly by the Packard Commission and others, by staying in an extended research timeframe and staying in that until you have confidence to go ahead. That is quite different than many other programs, sir, and I do believe that that augurs well for the future and the fact that these should not go up.

By the way, the cost analysis group, since I kept talking about the ways in which we managed the costs in the F-16, went back and checked that, at least while I was there. At the same time, when General Monahan, my successor was there, they did not go up, sir—just a little teeny bit.

Chairman NUNN. That has certainly been one of our best programs, there is no doubt about that, and you are to be congratulated on that one.

General ABRAHAMSON. Next slide, please.

SDS ACQUISITION COST EVOLUTION



It is probably worthwhile, and your staff suggested that I take the extra time, to lay out a little bit about this cost history, so that you can see what really happened.

You will recall that after we did an initial study, this study was an input into the Joint Chiefs of Staff, so that they could understand well enough what is possible and, thereby, then begin to think through what the basis of a real deterrent requirement might be. That is an iterative process.

I talked 2 years ago about an estimate on the order of $40 billion to $60 billion, in fiscal 1985 dollars, for the acquisition of a system like that. That was not a high confidence cost estimate. It was the first of our serious attempts to cost out what an architecture might look like.

When we came to the milestone one review over 1 year ago in June 1987, you had a range, and we had a range, and I would like to point out that that was a low-cost range at about $75 billion, and the space-based interceptor portion of that, since this is an area of great interest to you, was about $13 billion. But that was an optimistic interceptor. We had not achieved a technical basis at that point to say that we are absolutely confident we can do that.

We are trying to take a conservative approach and a responsible one as we go though each phase of this development program.

So, the conservative design was the high one, $145 billion, and the space based interceptor portion of that, $69 billion. That as-

sumed a more conservative one, where we would not have some of the technical progress that now already has been made.

As we went into this June effort, the system, the process said you can't carry these things. You've got to go for a single best estimate, and that is what we did.

We still had many elements of the conservative missile that were there, and, therefore, the $52 billion for the space-based interceptor portion of that represented a composite of some risk, some things that were outdated in the overall architecture, and the architecture was different, as well as still conservative technical estimates.

However, through the time from last January to now, the technical progress has been really remarkable, and we felt confident and the independent costers felt confident to look at what we have done and say yes, you should be able to produce something much closer to the simple, higher performance missile that was laid out.

But I want to point out that there are some differences in that architecture. Dr. Costello pointed out that some of them are not all cost savings. Some of them, in fact, are that higher performance interceptors allow you to have fewer out there where they can operate.

So, therefore, our current validated cost projection is $69 billion, and the space-based interceptor portion of that, the most dynamic portion of it, is now down to $17 billion. Notice that that is a little more than the $13 billion that we talked about in the initial part.

I have looked at how one establishes cost goals for the future. I am trying not to establish unrealistic goals, but challenging goals. I believe that, for the overall architecture, a cost of somewhere between $50 billion and $55 billion is realistic.

Now, if some really dramatic turn happens in the research, it might go lower. If there were a failure in the progress or if we were not afforded enough money to bring these things to fruition, then we might not get that far. But, clearly, that is the advantage of having the program stay in a research phase.

Next slide, please

ACQUISITION COSTS (FY88 $ B)

(As of October 4,1988)

ELEMENT	JUN DAB	SERVICE BRIEFS (Sep 88)	$ REDUCTION	% REDUCTION
BSTS - Boost Surveillance and Tracking System	9.0	8.0	(1.0)	(11%)
SSTS - Spaced-based Surveillance and Tracking System	12.6	9.2	(3.4)	(27%)
GSTS - Ground-based Survillance and Tracking Systems	3.6	3.3	(.3)	(8%)
SBI - Space-based Interceptor	52.0	17.7	(34.3)	(66%)
ERIS - Exoatmospheric Reentry Vehicle Interceptor System	4.8	5.8	+1.0	+21%
BM/C3 - Battle Management/Command, Control and Communication System	14.6	7.3*	(7.3)	(50%)
GBR - Ground Based Radar	2.7	3.1	+.4	+15%
SE & I - System Engineering and Integration	7.8	5.0*	(2.8)	(36%)
LAUNCH	8.3	8.6*	+.3	+4%
Cost Reserves (Imbedded)		[7.6]	DVMT = 10.4%	
Performance Reserves		1.1	PRDN = 14.4% +1.1	-
TOTAL	115.4	$69.1	(46.3)	(40%)

* SDIO ESTIMATES [ ] NON ADD

Here are the elements of that cost projection. You can see, for example, the surveillance systems on the top, the satellite systems, with $8 billion and $9 billion associated with those. Those are expensive, complex systems.

The space-based interceptor is at $17.7 billion. It includes launch, it includes engineering. In other words, these are the total acquisition costs in fiscal 1988 dollars, as the best possible way we can project them for the rest of the research program associated with those systems, for the development program that would follow, for the cost of acquiring the missiles and the elements that you put in space and the launch costs to put them in space.

It does not include the estimates for an operational phase and the O&S costs. We have those estimates, but I don't think they were that good yet for this.

I would like to call your attention to the bottom. I think we are doing something responsible here, too. The cost estimate includes a reserve, a risk reserve.

There is $7.6 billion that we have included in this cost as risk, risk for cost failures. I think that it is prudent to put this in at this

time. It is also the prudent recommendation of the independent elements of the cost analysis improvement activity.

About 10 percent of that is in the rest of the research program and in the development phase as we look ahead; 14 percent of it is in a production phase. We may not be able to achieve all of the capability for low cost production that we are driving for.

Now, I don't think many programs in this phase are including a reserve in their cost estimates. But I do think it is prudent.

I have a second reserve, and this is a little different, and no program that I know about has done this. That is $1.1 billion down there as a performance reserve. If, for some reason, this is not quite as effective in meeting the Joint Chiefs of Staff requirement, I included it, and there is a specific basis for that number, for a certain amount of additional ERISs and a certain number of additional space based interceptors.

So we do have a reserve in the overall program.

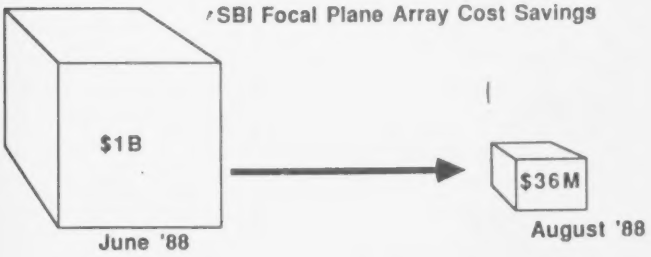
Next, please.

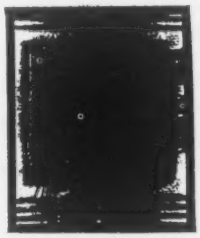
Advancements In Focal Plane Array Development Have Resulted In A 30 To 1 Reduction In System Cost

SPACE BASED INTERCEPTOR

64X64 HgCdTe Focal Plane Array Achievements

June '88	August '88
• CAIG Estimated $80/Pixel Focal Plane Array	• Demonstrated $9/Pixel Focal Plane Array
• Estimated Production Yields (~ 1%)	• Demonstrated Production Yields (~15%)




Seeker Focal Plane

Here is an example of why we think this is real.

I indicated that one of the important developments that really makes the performance improvement, that gives us confidence in that, is the development of the focal plane; the "eyes" of this missile. By the way, those "eyes" are also in satellites and on the ERIS ground-based missile as well.

In June 1988, the estimation was something like $80 to produce something like one, what is called a Pixel of information, and that really means a detector. But the fact that we have now produced low-cost focal planes—and I will show you an example—that can exceed our performance requirement allows us to go for a billion

dollars of investment in that kind of effort, down to what we would expect to be about $36 million.

Now, that is an example of success in the research program, success that I have been talking about over several years, of getting the bricks into place for an affordable program.

On the right is that Seeker focal plane.

I would like to show you some others that are real and show you some comparisons. May I have some assistance up here?

I have talked many times about the inertial measurement units and the progress we are making there. That F-16 inertial measurement unit, which is still in the fleet, is the one that Col. Pat Talty is showing you (indicating). That cost about $100,000. It is big. It is a good one. It works, but it certainly is not going to work for something that we want.

Where we are now in the research is with one that we believe can be built for about $5,000, and it is that small (indicating), and it is an entirely different concept. It is what we call a fiber optic gyro. That is only one of several different kinds of concepts. By the way, I think we will have even simpler ones in the next generation.

Now, we have also progressed in the rocket research. This is not so exotic, but we have made real progress.

Pat, would you show us the large rocket, please.

That rocket (indicating) puts out 300 pounds of thrust. It represents the technology that is flying today on some of our systems. It really represents a design of about 1970. It costs today, when we buy those systems, something like $150,000.

I will show you a television tape of tests with this particular rocket, which, by the way, puts out and meets a demanding performance, technical capability, puts out about half of that one. We expect it to cost about $20,000. And, by the way, it is already well on the way to being space qualified. That is where you have problems with these systems.

Next is the rocket itself, the large rocket (indicating) that you can see will be the size of the space-based interceptor. I have shown you several different versions of that. Here is where we think we are in terms of the size of it. You can see that it is not very big (indicating).

Obviously each time it gets smaller, it gets less expensive, and the cost of launching such a system gets less.

The front end, of course, is the expensive part, and that is where the focal plane and all the other work is.

If you will take a look at the large vehicle (indicating), this is only a model, but that particular system is being assembled up at Boeing. It is one of the advanced concepts. There are five different concepts that are being pushed very, very rapidly. That is where we are today.

The next model you have seen before. It is the generation that will come behind that and is only a few kilograms (indicating). I will show you some of the performance of the focal plane of this particular model.

But the key to that performance is the progress in computers. If you can see that board (indicating), this board represents a computer that will make those focal planes work 2 years ago. It is complex, with a lot of signal processing as we go through it.

The next one is where we are today with the board (indicating), and this is not startling. This is what is happening in the electronics industry all over.

In this one (indicating), we have produced the first of the chips that will have all of that function in that small chip, over there (indicating), and that will be, I believe, the one that we will build as we finally get there.

Now, I have talked about the focal plane. Would you hold up the focal plane, please (indicating).

Probably the most important development is the focal plane, or the "eyes," which are going to be ones that scan back and forth. It imposed itself on the computation problem. It was a difficult one, was not very sensitive.

Senator WILSON. Mr. Chairman, let the record show that Colonel Talty was actually holding something in his hand. With the vision of most of the members of this panel, that needs to be said. [Laughter.]

General ABRAHAMSON. Even for an old test pilot, I have to use these glasses once in a while, sir, to see that.

That focal plane is a staring array. In other words, it looks more like our own eyes. It can stare until it sees and it can see more effectively. That gives it a longer range and is probably the key that enabled us to take the fire control component off the carrier vehicles.

I would like to show you some of this in action, if I might, and how we are testing it because it is real and it is in test today.

[A video was shown.]

This is where we test the focal planes and inside, where we can fly simulated missions. We're testing the real software. Often people say software doesn't work or won't work in the future. They talk about some future problem.

What you saw there, in fact, just very briefly, was the software algorithms working now, today, in simulation chambers.

We fly the mission. We establish what kind of corrections and what that rocket will have to do as it goes out for just a few seconds over time. Now we take the engines, the qualified engines, we put them together with the guidance system, and we fly a simulated—in this case, it is strapped down—mission with that. I will show you that coming up in a moment.

These are the small engines. What you see there is a large divert; it is the one that I showed you. Those are the things that, as the space based interceptor flies out to intercept, it will, in fact, move it huge distances to the side, so that it can run into the Soviet missile. Then there are small motors, which keep it aimed in the right direction.

Here you will see a full 28 second firing that works. It is a combination of the inertial elements of the guidance system and some of the most advanced, powerful engines ever created.

You can see that the large one is the divert engine and the small ones are keeping it aimed right, if it were firing in space.

This occurred in July, out at the Rocket Lab. They are an enthusiastic bunch, as you can see. Hopefully, in about a month, we will have that kind of facility flying and hovering in mid-air. In about 6

months, it will be tested with the focal plane against rocket firing on the ground.

Within 1 year to 18 months, we will be in a position to do treaty compliant testing, narrow treaty compliant testing, sir, of these kinds of systems.

That is the progress that has been made, and it is real.

Senator GLENN. If I might interrupt, Jim, what is the thrust of that, and can that be scaled up to larger sizes?

General ABRAHAMSON. We have been working to make it smaller, sir. It can be scaled up. Some of the concepts can be scaled up.

Let me just show you an example.

Senator GLENN. Are there limits up and down, or can the concept be used for any size?

General ABRAHAMSON. I personally think that the key to this is the material that we have built into it. I have not tried to think through how carefully these material limits might apply for a large design. But let me offer you a different one.

This is one version by one contractor.

Could you show the platelet design.

Senator, you know that we use platelet concepts on the Shuttle. We have taken that concept a lot further. That particular engine is one that will go on the HEDI, the ground interceptor. That engine has the power of the F-16 engine or the SR-71 engine. It is about 30,000 pounds.

The important thing about it is that it is a very, very low cost production technique that we have implemented.

If you will take the next one, the one right next to it (indicating), here is a small version of this technique, where we have learned from the way we make electronics and to try to make very complicated motors and injectors in a very small way by just putting plates together.

I think that is the one that offers scalability, more so than this one (indicating).

May I just have the summary chart, please.

Oh, there is one more here.

We are making a lot of progress that can be applied to other systems. Now, that focal plane, here is a test, here is the focal plane (indicating). It is a small staring array, a tiny, tiny chip.

Here we are using it in the atmosphere to track an airplane. Now there the airplane is up fairly close, just about 8 miles away. But it can be applied further.

If you look very carefully, you can see moving at 87 miles away against a very difficult background and some light clouds not only a large airplane, but four fighters are coming in and closing on it.

If we look at sequence five, what you see is at 102 miles the tracking, with that particular focal plane, of an airplane.

Now that looks pretty dim here. That is because it is unaugmented.

We also have completed the kinds of algorithms to electronically enhance that and to take out background and make it very bright. But that is the raw system working.

Obviously, there are people who are building infrared missiles for airplanes and other applications that are very interested in the capability that we have developed here.

Now I will just go to a summary.

SUMMARY

- Phase One Is A Flexible But Well Defined Concept With Growth Potential
  - Meets JCS Requirements
  - Have Achieved Dramatic Cost Projection Reductions
  - Further Cost Reduction Efforts Are Underway
- Investment For Technology Base, Advanced Weapons Exceeds Phase One (Over FYDP)
- Zero Two Or Follow-On System Study Is Well Underway

This was a summary that was presented to the DAB.

We think that Phase I is flexible. It is a well defined concept. It has growth potential and additional cost reduction potential. Obviously, it meets the requirements. General Herres commented on that. That has been examined in lots of different models, in different ways.

I believe that, through the results of really dedicated efforts by wonderfully creative people out there, we have created these dramatic cost projection reduction opportunities. They are there. And there are additional ones that are underway.

If you could, show the Brilliant Pebbles concept, please. You will have to pick it up.

[Model was displayed.]

This is one that is a controversial one. It is being advanced out of the Lawrence Livermore Laboratory. It is where people have taken some very, very small component work and put it together in an unusual way. They have offered some different concepts of command and control. This, at least, is one direction that is affecting everybody's thinking.

It may not turn out exactly like that, but the important thing is this kind of next generation concept should offer us even further cost reduction as we look ahead.

Now, finally, in the last few months that I intend to be on the program or will be allowed to lead it, we are also working on the first studies for the definition of Phase II and the follow-on systems. We need to do that so that we can provide that to the JCS for a very careful analysis, so that they can set the follow-on requirements, and we can begin to see how those work very carefully with this first Phase I system.

It is very promising.

I am not ready to make a responsible cost projection yet. There happen to be a lot of other people who are irresponsibly making those cost projections. But, nonetheless, it is very promising for the follow-on part as well.

We are working toward affordability. But, Senator, you asked one very vital question. You said are you still using the Nitze criteria, the cost effectiveness at the margin? The answer is absolutely yes.

That is a Presidentially mandated criteria. It is an important one for us.

Chairman NUNN. What about survivability?

General ABRAHAMSON. Oh, of course. That is absolutely there. I think we can only talk about that in any detail in a classified session.

However, we believe that we have now done excursions to check the survivability of this architecture against even more demanding threats than we ever have in the past, and we believe that it can be survivable.

There is additional work that has to be done in that area; but it is a very encouraging picture there.

Two years ago, when I started talking about affordability, people asked me are you trying to substitute that for the Nitze criteria. The answer is of course not.

The Nitze criteria are an important part of being able to make this go forward and, in fact, achieve the right relationship in terms of arms race stability with the Soviet Union. It is an important part of our ability to be in the proper posture for arms control negotiations themselves, and to not have the Soviets be feeling that they can just build more missiles and overcome any future system.

But affordability is an equally important criteria. Even if we passed that one, we have to be able to fit it into the budget in the context of many, many different national priorities. I believe that we are going to be able to do that.

Thank you.

Chairman NUNN. Thank you very much, General Abrahamson, for a very interesting presentation this morning. We appreciate all of our witnesses being here.

I know that we have a lot of members present and I am going to ask that the time be kept. We will have a 5-minute rule for each member. We will rotate.

I suggest that we have a Senate Democrat and House Democrat, and then a Senate Republican and a House Republican.

Is that all right?

Senator WARNER. [Nods affirmatively.]

Representative DICKINSON. [Nods affirmatively.]

Chairman NUNN. Dr. Costello, at what point in the milestone process do you plan to determine independently that a proposed SDI Phase I would meet the Joint Chiefs criteria?

Dr. COSTELLO. I think we continually review that at every milestone to make sure. When we had milestone zero, we said yes, we have a mission requirement. Then we went to milestone one on these elements, the six elements that we are looking at, the building blocks. At each step we have to look at the Joint Chiefs' criteria and make sure we meet it.

Chairman NUNN. So it is continuous?

Dr. COSTELLO. Absolutely.

Chairman NUNN. General Herres, would it be fair to say that there has been a certain reduction of capability in getting these costs down?

General HERRES. That is not evident at all, Senator, at this stage of the game.

What lies ahead for us is the concept demonstration-validation phase, during which we will find out not only whether or not these cost projections are good, but whether or not the performance projections are good.

But there is no reason to think that there is going to be a significant change in performance of the system. There probably will be some modest change in performance.

Chairman NUNN. We are cutting the number of space-based interceptor garages in half, correct?

General HERRES. Yes, sir.

Chairman NUNN. And we are removing the autonomous fire control sensors from the garages, is that correct?

General HERRES. That's correct.

Chairman NUNN. Third, we have a significant scaled back communications capability on each garage.

General HERRES. There is a reduction there. But it is really done in a different way.

I hesitate to say yes because it is being done in a different way.

Chairman NUNN. There is a trade-off on that one, isn't there?

General HERRES. That's right. Yes, sir.

Chairman NUNN. How about the elimination of the self-defense from the garages?

General HERRES. Well, to get into survivability, as General Abrahamson said, I think we would have to go into a closed session. But we have looked at the survivability aspects of this and there is good reason to think that the Phase I requirement could be met as the survivability criteria are laid out.

Chairman NUNN. With the deletions that you have made to get the costs down—and I am delighted that we are able to project the costs downward—with those deletions, are we now relying almost solely on the BSTS and the SSTS satellites?

General HERRES. There would have been considerable reliance on those satellites before, particularly the BSTS, even under the old concept.

Chairman NUNN. But aren't we increasing the reliance on those?

General HERRES. That's true.

Chairman NUNN. Now, the 1984——

General HERRES. Excuse me, but I think Jim wants to qualify that.

Chairman NUNN. I only have 5 minutes, so let me pursue this for just a minute.

General HERRES. All right. But I think it would be best to defer the details of where those trade-offs lie to General Abrahamson. I am not really the best qualified person to address that.

Chairman NUNN. All right.

I am not trying to get into the details.

The 1984 Fletcher report, which was the administration's first comprehensive assessment of SDI, contains the following statement:

> Assessment of the vulnerability of responsively hardened targets to lasers, particle beams and X-ray weapons is the single most important issue in determining whether there is a feasible concept for development and ultimate deployment of the Strategic Defense System.

What are the Joint Chiefs projecting in terms of the gains the Soviets may be able to make over the next 10 or 12 years in the areas of ASAT lasers, particle beams, X-ray weapons, and direct assent missiles?

In other words, the bottom line is how confident are the Joint Chiefs that our BSTS and SSTS survivability efforts can stay ahead of the Soviets in this area?

General HERRES. Obviously, again, I cannot get into too much detail. But we are concerned about those threats to those particular vehicles, whether there is an SDI program or not. In other words, the survivability of those systems is of concern.

We depend on the intelligence community for the kinds of projections you asked about. The picture is murky. The collection of intelligence about those kinds of systems is very, very difficult.

Chairman NUNN. But we are raising the stakes now if we depend on those systems for the workings of basically the entire system, are we not?

General HERRES. No, sir. I disagree with that.

The stakes are already high. They were high and they would have been high whether there had been an SDI program or not.

Chairman NUNN. We are spending a lot of money on a system that will depend on the survivability of systems that already are of concern to us. Would you agree with that statement?

General HERRES. We have to do that, Mr. Chairman, because our strategic offensive deterrent is going to depend very, very heavily on the BSTS. It is a hollow deterrent without the capabilities of advanced warning systems.

Chairman NUNN. Would you say the same thing about the defense program we have seen outlined here today?

General HERRES. What I just said applies in a different way.

Certainly, this system depends very heavily on that BSTS as well. I would say that dependence is probably quite comparable between both the defensive and the offensive systems on the BSTS.

Chairman NUNN. My time has expired.

Thank you.

Let me go to Mr. Spratt, and then we will rotate to Senate Republican and House Republican.

Representative SPRATT. Thank you, Mr. Chairman.

General Herres, General Abrahamson, Dr. Costello, thank you for your testimony.

Ed Gerry is a consultant of yours and he has written a letter that received some attention last year. Chris Cunningham, at Lawrence Livermore, did a short piece that raised some questions about the effectiveness of SBIs. Both of them went to the same point, that if we look at the Soviet ICBM force responsively adapted, foreseeing the onset of SBIs, if we make modifications to it that they can easily adapt, then the SBIs will be extremely stressed in the boost phase.

In fact, Cunningham suggested that if we assume that the Soviets will have 600 SS–24s, 600 SS–25s, booster burn times of 180 seconds, possibly improved by about 30 seconds, and PBVs cut by 45 seconds, all of which they thought could be done with easily adaptable technology, that it will be virtually impossible to have a boost phase intercept system. This will have to become or chiefly concentrate upon being a post-boost phase intercept system.

Now, assuming those premises are correct, if this is the case, how do you expect to be able to sense the PBVs or the RVs and at the same time reduce or downgrade the sensor suites on the SSTS and, for that matter, the carrier vehicles?

General ABRAHAMSON. First of all, let me put the Chris Cunningham study in the proper context. That was part of our Red Team activity. That is not somebody trying to shoot this system down.

I had asked them to develop what they thought, based on their experience and capability in designing nuclear weapons, was needed to come up with something that could try to defeat this system.

The final report assumed, in what I call the fallacy of the last move, is that we would do nothing to the space based interceptors during the period of time that we saw the Soviets developing these.

For example, it assumed that we would not change the deployment altitude, which is always available to us, a series of other kinds of activities. This one, that you see, one of the main reasons that the performance is greater for a smaller number of missiles is because it goes faster.

Chris did not consider that in any of his activities. Therefore, I believe that it is important to put that in context.

One, the trend is correct.

Representative SPRATT. Then would you agree that we are really trending toward a post-boost phase intercept system, rather than a boost phase intercept system given the likely responsive measures the Soviets will take?

General ABRAHAMSON. I don't believe that we are there by any means, yet. I don't think that all of our other indications show that. And we are going to try to maintain a clearly important boost phase capability.

However, the important thing is, even if we were surprised by the Soviets, by all of those kinds of developments and things that were more optimistic than that, the system is not invalidated because, in fact, it becomes a post-boost capability.

These are not obsoleted as one goes ahead.

It does, however, put additional weight on the strategy that it laid out long ago, which I called "branch and block." That means that we have to have a relationship between each of the things that we develop and as we go through the research phase of the program.

It is important to us that we demonstrate that, with lasers, we can counter those kinds of systems early enough in the process that the Soviets see that it does not make sense to go in that direction. But if we only did those other things they would be free to concentrate on discrimination problems or others so that you would not be able to go ahead. That is what I've tried to explain in the balanced approach.

Representative SPRATT. I assume that in this context we cannot talk about your scheduled timeframes for bringing the system full-up.

General ABRAHAMSON. I believe we can, in the sense that it is quite reasonable in the latter half of the 1990s, late in the latter half of the 1990s. That is what we are projecting at this point.

As we simplify this, I hope we would be able to bring that forward.

Representative SPRATT. What would be a reasonable expectation for the free electron laser, if it were your candidate DEW system?

General ABRAHAMSON. Well, if the free electron laser were the only directed energy system and we concentrated only on that timeframe, it would probably be perhaps 4 or 5 years behind that, depending on some fairly fundamental physics issues, for example, a ground based free electron laser. We still have not solved the fundamental physics issue of can we get the high power beam up. We have a lot of confidence and we are gaining ground on that. But that does not tell us, and we won't until we get a full-up capable system. And because we have that element of risk, I, as a conservative and responsible program manager, should not be proposing that we put all of our eggs into that one basket, particularly since I believe that the right system will have a balance of those things, the triad that it talked about.

Representative SPRATT. I would like to come back to that, but my time has expired.

Chairman NUNN. Thank you, Congressman Spratt.

Senator Warner.

Senator WARNER. Thank you, Mr. Chairman.

On our side, I would like to invite Mr. Dickinson to lead off, and then I will take the Senate position.

Chairman NUNN. Mr. Dickinson.

Representative DICKINSON. Thank you.

I have just a couple of rather mundane questions, General.

One of the biggest elements in the debate after the President's veto had to do with the SDI program. We spent a great deal of time, the three of us, and Chairman Aspin, removing the earmarked funds for the various program elements within the SDI program.

As a result, I think we have given you flexibility to do what you deem necessary and proper as you continue with research and development.

I wonder if you would give us the benefit of your thinking as to what we did for you and what we did accomplish in removing the program earmarks.

General ABRAHAMSON. Yes, sir.

This is the most complicated program that anybody has ever put together. There is a huge, technical base that goes behind every one of these things. You have seen some examples of that technical base.

By removing the fences, you have done two things. One, you have not artificially restricted our ability to go ahead on what is clearly an ever-more promising technology, and I think that is vital.

But, second, you have enabled all of us in the program to bring the program forward with a level of integrity that is critical. Let me try to explain this.

Behind every one of these projects is this technology base, and I would have had great difficulty in trying to explain not only to you all, who I think would be quite reasonable in that, but to all of the auditors who would then follow along afterward and say did you exceed that particular amount or not. We would have to argue about each of these elements, an inertial measurement unit or a focal plane, that in many cases are being developed in such a way that they can be applied to two or three different systems. Frankly, we would have had a great deal of accounting problems for that.

Dr. COSTELLO. Mr. Congressman, I think, philosophically, if you start fencing early in the game, in an exploratory program of this type, you may fence the money in the wrong place. The program manager really needs the flexibility to move it, as he sees fit, which the General described.

Representative DICKINSON. General, as I recall a conversation you and I had in my office shortly before the markup, you were very concerned that you were going to lose a lot of employees, that they were going out the gate and you were not going to get them back.

Would you comment on that?

General ABRAHAMSON. Yes, sir. Actually, we lost them.

Representative DICKINSON. You did lose them?

General ABRAHAMSON. Yes.

I had cash flow problems in fiscal year 1988. It appeared that that funding limit was going to be there, and over 1,600 employees at several of the contractors on this particular program were let go.

Now that that has been restricted, we are trying to put together and recover from that as best we can.

Representative DICKINSON. One final question. I have read in the papers that someone, one of the candidates, suggested that all research for the total program be limited to, say, $1 billion. What are you going to buy for $1 billion in this program?

General ABRAHAMSON. Sir—and this is not a political statement—I think all of you know that that was the level of the research that was pulled together even before the speech. At that point, there was no real SDI program.

What it means is that there would not be a program. There just flat would not be a program. You would never be able to make the

decision, you would never have the capability to make the decision that you need to be able to make.

Dr. COSTELLO. Sir, it is our estimate that we were doing about $1.5 billion of work in related activities that we put under the SDI program, so it would not even cover the work that we had underway.

Representative DICKINSON. Thank you, Mr. Chairman.

I yield back.

Chairman NUNN. Thank you, Congressman Dickinson.

Senator Warner.

Senator WARNER. Thank you, Mr. Chairman.

General Abrahamson, I'm going to ask you the same question I have asked you each year for 4 years when we have had these hearings, and that concerns the implications of the ABM Treaty on the work that you are undertaking.

The resolution of that issue is something I hope the next President proceeds to work with the Congress on, and the Soviet Union and others, at the earliest possible date.

My first question is you are now working under the narrow interpretation.

General ABRAHAMSON. Yes, sir.

Senator WARNER. Could you work, continue the research program, under a broad interpretation at less cost to the American taxpayer and a more effective technological goal being pursued?

General ABRAHAMSON. Our best judgment is that whenever you take restraints off a program, you can find efficiencies in terms of the way you test, and you can move more quickly toward an effective test. Therefore, the answer is yes, sir.

Senator WARNER. It would be more cost effective if you were now given the latitude to proceed under the broad interpretation of that treaty. The answer is yes, is that correct?

General ABRAHAMSON. Yes, sir.

Senator WARNER. And you would have a wider range of technical goals that you would pursue. Is that also correct?

General ABRAHAMSON. The answer is yes. Yes, sir.

Senator WARNER. Well, now, given the fact that we are not likely to resolve that in a short period of time, you must continue your research program under the restriction.

At what point, in what year in time are you going to shift, of your successor, from the research to the next milestone, which is full-scale development?

General ABRAHAMSON. Sir, certain other things—and this was, of course, the recommendation of the Defense Science Board and the guidance by Dr. Costello and others—that we ought to, in fact, take steps as we go forward. Some of those steps are involved with sensor systems. It will depend on some future compliance decisions.

But we have made such progress in the BSTS satellite that we expect that we would like to begin some early development investment in the fiscal year 1990 timeframe.

Senator WARNER. Fiscal year 1990?

General ABRAHAMSON. Yes, sir—in that budget, in the fiscal year 1990 budget.

Senator WARNER. Now at that time, the issue of the narrow versus broad becomes even more of an impact on the cost effectiveness. Am I correct in that?

General ABRAHAMSON. That's correct, sir, although it does depend on compliance decisions that are yet to be made.

Senator WARNER. So, would you conclude that there is a sense of urgency that the next President must accept in trying to resolve that decision with the Congress, our allies, the Soviet Union and other interested parties?

General ABRAHAMSON. I believe that the technical program would clearly benefit, and I believe that the sense of my report, which I sent to the Congress, was that the program can go ahead effectively for a period, but it is not as efficient.

Senator WARNER. Both technically and cost-wise?

General ABRAHAMSON. That's correct. And, obviously, if we can have freedom to test as early as that can be established, that will make it easier, and you can have more planned and responsible test programs, which will gain a larger benefit.

I think that that is fairly straight-forward and self-evident. That is not a statement in terms of trying to make a judgment about the policy issues associated with this.

Senator WARNER. No, that is above your pay grade. I understand.

Dr. Costello, I will yield to you in just one moment. General, you said "for a period." Can you define that phrase, "for a period," in terms of months and years?

General ABRAHAMSON. Well, it depends on the compliance decision process. That is a difficult one.

Senator WARNER. What are the parameters, in your judgment?

General ABRAHAMSON. You will recall that in the spring, we worked very hard to, in fact, come up with a curtailed type of test for the space-based interceptor, one that could be accomplished under the narrow interpretation of the treaty. We did that, and Dr. Costello and others examined that very carefully and were able to certify that particular test.

The members in the future who see the results of that test will have an interesting dilemma, and that dilemma is will that test provide enough confidence so that they can then say yes, we are ready to go ahead or not, and the confidence will be the result not just of a demonstration, but because the tests are curtailed, simulations, tests in space, but curtailed tests in space, and other activities as well.

It will be a complex decision.

Senator WARNER. Thank you, General.

Dr. Costello.

Dr. COSTELLO. I think it is important that we recognize at some point we will have to have the broad interpretation or break out of the treaty, whatever. But that is way down the road.

Senator WARNER. Now "way down the road" is too loose a phrase because we are expending billions and billions of dollars of taxpayers' funds. We have to have a more precise answer than that.

Dr. COSTELLO. Some time during fiscal year 1990, we will come in and give a costing of the options for a narrow versus broad treaty requirement.

Senator WARNER. Now that is being precise.

Dr. COSTELLO. That's what we have to do. That is our responsibility.

Senator WARNER. And that is part of the next budget presentation, then, in the February timeframe?

Dr. COSTELLO. I think it will be during fiscal year 1990 that we have to look at that. I indicated in the testimony that when we had our next report and we looked at the budget, we would have to focus on that, coming back with costed options saying what the differences will be.

Senator WARNER. Now, the President will present a budget next year. As a part of that budget presentation, will you be addressing those options?

Dr. COSTELLO. Yes, we will, we have to. That is what the General has indicated also.

Senator WARNER. All right.

Chairman NUNN. Do you have any indication when "way down the road" is now? Do you have any idea? You are saying that you will present that analysis next year.

Dr. COSTELLO. I have taken the position that the longer we can delay without having a cost impact, it is in perhaps our best interests.

Senator WARNER. Delay what? Delay the decision?

Dr. COSTELLO. No—delay the requirement for a broad versus narrow interpretation of the treaty. We have been here before, in the spring, saying we are going to stay with the narrow interpretation. That is the current intent.

When we have to do something else, we have to come back and tell you, which is what we said we would do. And I think we also have to cost it out so that we are aware of the impact of these decisions on the budget.

Senator WARNER. And you are coming up in the 1990 presentation with those cost estimates of broad versus narrow?

Dr. COSTELLO. I'm looking at the General, and with the schedule that we have, we have to, in the 1990 timeframe.

General ABRAHAMSON. I believe that the domestic law threshold that we testified in the spring, that we will come up in such a way that that has to be addressed, and we owe you that information.

Dr. COSTELLO. Last spring, we indicated that for 1988 and 1989, there was no compromise; there was no situation where we could not live with the narrow interpretation. But we did indicate that there would be a time when we would come back and tell you.

Senator WARNER. One last question and then my time is up.

You said, Dr. Costello, "when there is a cost impact." The General, if I understood him, said there was a cost impact today.

General ABRAHAMSON. There is.

Senator WARNER. So that cost impact, and I don't know the magnitude of it, is in existence today.

Am I correct on that, gentlemen?

General ABRAHAMSON. Yes.

Senator WARNER. Let the record show that the General nodded in the affirmative.

Chairman NUNN. Let's ask Dr. Costello if he agrees with that, because I don't think he does.

Dr. COSTELLO. I don't think it has been fully defined, sir. We have to know how big it is or what it is.

Chairman NUNN. At this point in the record, if I might have permission, I would like to read what the Fletcher report says about that, this being the report to the Secretary of Defense, because it is relevant, Senator Warner, exactly to your point.

> The notion of the broad interpretation of the ABM Treaty has been promulgated presumably to give the SDIO program greater flexibility to plan and carry out the testing program. In fact, it has had the opposite effect. The present testing program is in a strait-jacket. This has come about in large part because in the course of the debate on narrow versus broad interpretations of the treaty, the narrow interpretation of the treaty itself was squeezed by both opponents and proponents of SDI so that it lost all reasonableness. Whatever else is done, a way must be found to terminate this debate.

There are many people who believe that, in an effort to sell the broad interpretation, there has been an overly restricted definition in the Department of Defense of the narrow. And in an effort to make the broad look necessary, the narrow has been projected as more narrow than anyone would logically have concluded.

So I think that part has to come into your analysis to determine how much of the restrictions are based on a real reading, as opposed to a gamesmanship reading, of what the narrow means and does not mean.

Dr. COSTELLO. This is the direction that the Defense Science Board, the Everett report, also indicated. That is why I said we are going through that in a very careful way.

Chairman NUNN. That is the Everett report that I was reading from. I don't know if I had identified it correctly.

General Herres, did you have a comment?

General HERRES. I was just going to say that I believe you had said "Fletcher," but you meant "Everett report," I believe, didn't you, sir?

Chairman NUNN. Did I say "Fletcher?" I meant "Everett," yes.

Next Is Senator Bingaman.

Senator BINGAMAN. Thank you, Mr. Chairman.

General Abrahamson, let me just clarify what I believe you testified to a few minutes ago, and that is that the change in cost and other changes have resulted in a new schedule for the deployment of Phase I, and it is now estimated, and I think you said—I wrote down what you said—and you said that it is now estimated that it would be late in the latter half of the 1990s. Is that what you said?

General ABRAHAMSON. Yes, sir, I did.

It is not merely the architecture. We have several things that are happening.

Senator BINGAMAN. I have a followup question on that.

General ABRAHAMSON. As part of the budget compromise, what has happened is that the amount of money dedicated to the program over the FYDP has been reduced. We had to find a way to live within that. So that had an impact of delaying part of the Phase I.

Senator BINGAMAN. So Phase I could not be deployed at least for 10 years, under your present estimate?

General ABRAHAMSON. No. That's the space based interceptor portion of it in our present projection. As we simplify that, I believe we will be able to bring that back to the left.

Senator BINGAMAN. Let me ask this. In light of that projection, as you now have it——

General ABRAHAMSON. There are other parts of the program, however, that can be deployed and, in fact, will need to be deployed first. The BSTS satellite, for example, is required not only for an SDI requirement, but you heard General Herres' comment that we need that for an improved warning for our present system. That will come first.

Senator BINGAMAN. I am concerned, I guess, about the balance between Phase I and Phase II. I think that was sort of the root concern which underlay a lot of the dispute between the Congress and the administration on fencing language. The question of which of the various legs of the triad in the illustration you put up is getting the resources and getting the attention. Two of the three legs of that triad, as I understand it, the laser and the particle beam legs, those are part of the directed energy program and those are Phase II.

General ABRAHAMSON. Yes, sir.

Senator BINGAMAN. Also, according to the information we have gotten from your staff, in this next year, 1989, it is estimated that the second phase, the laser and particle beam combined, the funding for those would drop below the 20 percent of the total budget that you have.

So, those directed energy weapons would be getting less than 20 percent.

It is also pretty clear from the figures that I have been given that the amount going to directed energy funding will have dropped in each of the last 3 years, and, in fact, will be, in 1989, about 20 percent below what it was in 1986, in real terms.

I guess what I am concerned about is this. In light of this delayed deployment of Phase I, should we go back and rethink the balance between Phase I and Phase II? I think the directed energy weapons part of the SDI program is getting less attention than I think it should, and I think that has been the view of quite a few in the Congress, and that has been the motivation behind fencing some of the funds.

General ABRAHAMSON. Sir, in terms of the overall funding for directed energy programs, I have not calculated by your 20 percent. I would have to go back and confirm that.

There is no question that every part of the program is being cut back and cut back dramatically because of the reduced levels of funding.

Senator BINGAMAN. But there has been an increase in the overall SDI funding from 1986 to 1989 of over $1 billion, and in that same period the directed energy funding has gone from $796 million to $716 million. That is my information.

General ABRAHAMSON. That's not such a major cut, compared to the overall activities that have gone underway.

Let me just remind you that a very substantial amount of Phase I will be required for a laser system in space. We will need the BSTS satellites. You will probably need, in fact, some version of

the SSTS, and you will probably need some radar capability as well.

So you should not count only the Phase I against directed energy.

By the way, I share your concern. Those are very high priority programs, and I am trying, in fact, to fund them both at a rate in which they can go ahead efficiently from a project viewpoint and fit within the overall budget.

This is because they are making extraordinary progress as well.

Senator BINGAMAN. General Herres, let me change gears and ask about another item.

I understand the Department of Defense has made a decision to terminate the Sea Lite Beam Director or is about to, the beam director associated with the MIRACL laser.

I guess I am concerned that this involves throwing away some capability that we have and particularly, in light of the delay in some of the other programs, the free electron laser program and all. I have wondered if that decision is a wise one. I would urge you to reconsider the termination of that MIRACL laser director and see if there is funding anywhere else that could be used for that.

Obviously you need to know your own priorities, but that would be a concern that I would urge on you.

General HERRES. Thank you very much.

We have looked at that, Senator Bingaman, and I will take another look.

Senator BINGAMAN. I would appreciate that.

General HERRES. That is not an easy decision. But the rationale could not be discussed here this morning.

Senator BINGAMAN. I would appreciate it.

Thank you, Mr. Chairman.

Chairman NUNN. Thank you.

I believe next is Congressman Darden, and then I will be shifting to the Republican side for Mr. Wilson and Mr. Kyl.

Representative DARDEN. Thank you, Mr. Chairman.

First of all, I want to welcome our panel today and to say to you, in particular, General Abrahamson, I think you have served with competence, with dedication, with integrity, and we shall miss seeing you at these hearings. I want to thank you again for your years of dedicated service to the program.

We have talked about this subject, gentlemen, piecemeal this morning. I have read articles that have been in the various national publications suggesting funding levels, but I am unclear right now as to what these reductions are going to amount to in overall funding requests.

If we have covered this piecemeal, I would like to come back to it and see if you can tell us this morning what will be the overall SDI request for fiscal years 1990 and 1991 and for the remainder of the 5-year budget cycle?

Dr. COSTELLO. We're putting those numbers together and we will provide that to Congress later in the year, specific details each year, for the 5-year look.

Representative DARDEN. Are you in a position to tell us now what it would be for fiscal year 1990?

Dr. COSTELLO. Not at the present time.

We'll get it to you as soon as we can.

Representative DARDEN. Thank you very much.

That's all that I have for the panel.

Thank you, Senator.

Chairman NUNN. Thank you, Congressman Darden.

Senator Wilson.

Senator WILSON. Thank you, Mr. Chairman.

General Abrahamson, it has been alleged by the critics of SDI that the program goals have changed and that you are no longer working toward the President's goal of population defense.

Is that true?

General ABRAHAMSON. No. That is absolutely wrong.

By the way, I believe that comes from people who just flat do not understand what layered and area defense means, and, therefore, as they see that we talk about some ground-based components, they try to relate that to the old ABM system.

I think that is fundamentally a lack of understanding. Let me assure you and everybody that the goals have not changed.

Senator WILSON. The recent Phase I architecture change, does that indicate that the overall goal for deterrence of a Soviet attack has been changed?

Are we now resigned purely to developing limited protection systems? I think you have already made that clear, but perhaps it is necessary to repeat it.

General ABRAHAMSON. Absolutely not.

I think perhaps General Herres can, in fact, address that more completely.

General HERRES. As I indicated in my remarks, the requirement remains the same, Senator Wilson. The fundamental basis for the requirement is deterrence, deterrence of Soviet nuclear attack. The Phase I capability represents the least militarily significant capability. It gets across the threshold beyond which we can introduce uncertainty into a Soviet planner's mind when he begins to think about an attack.

Dr. COSTELLO. I think also the Secretary's guidance gave no indication of any change in the goals, and we have not entertained any change in those goals.

Senator WILSON. Then does the increased emphasis on the midcourse interceptor, the ERIS, and the increase in the ground-based battle management functions indicate that you have less confidence in the viability of your space-based elements?

Dr. COSTELLO. I will give it a cut, first, and then the General can go at it. I think it is inherent in the approach that the program office has taken that there is flexibility that this is a triad not only in weapons technology, but also in the architecture and attack philosophy for the boost and post-boost phases, and later in the trajectory.

It is important that we maintain this flexibility. As we have new technologies made available to us, some of which the General talked about this morning, we are going to see continued shifts from one aspect of it to another. But certainly balance is the key. I use the concept of maximizing the cost to the Russians, and I think that is inherent in the philosophy that the General expressed this morning.

General ABRAHAMSON. Senator, the answer from my viewpoint at least, is no. In fact, I believe that our confidence in the space-based element, both its affordability and its performance, even in a much more demanding threat environment, is gaining.

We are clearly feeling very bullish about exactly what its contribution and its performance can be.

Senator WILSON. General, why is the space-based interceptor so important an element in the first phase here? Why isn't a ground-based system sufficient to accomplish your goal for Phase I?

General ABRAHAMSON. As I tried to indicate first in the philosophy, the multiple layered concept, if we really want effective deterrence and we want that to operate, particularly when the crises begin to make people ask rather terrible questions about shouldn't we go first because we might have to, because it is inevitable, the layered defense is what gives the Soviet war planner this terrible problem that says he'll never know which missile gets through the first layer, and that that will also be the one that gets through the second and the third.

That is why you want to give him a very difficult probability function and the space-based element is what provides the first of those layers, and, in fact, I believe, as such, causes the most, it has the largest contribution to deterrence.

Now, when you get into the flexible architecture, if we only fielded a narrow, either a space-based or a ground-based element or lasers, all by themselves in the future, then the Soviet research planner for their offensive systems will only have to deal with a very narrow range of systems that they have to counter. It will be much easier for them. That is what we are trying to avoid.

Senator WILSON. General, the models that you have brought today and the stories that you have told us about miniaturization and the savings of literally billions and billions of dollars I think is not just heartening, but I think it is a remarkable story, and it indicates to me that we ought to have full confidence in the ability of SDIO to achieve the Nitze criteria of being cost effective at the margin, which, I would point out, is a criteria that we apply only to the Strategic Defense Initiative. We don't apply it to other major strategic systems. If we did, some of them would disappear.

Let me just ask you this question, pursuant to something Congressman Spratt asked.

If fast burn boost technology is so cheap and easy to do, why aren't we doing it?

General ABRAHAMSON. It's not.

What really happens in the end is that that is a very tough development. There are moderate levels of faster burning capability that is probably fairly straight-forward.

We have looked at that very carefully. We have a very extensive structure of Red Team examinations, and the study by Chris Cunningham represented one of those. There are some real regrets that they have on the other side.

I think that they can get to a moderate burn booster fairly straight-forwardly, and some of their systems represent that kind of advance today, just as the MX is much faster than some of our earlier liquid systems.

On the other hand, to go to this extreme level that people are talking about, you already achieve an important part of the SDI requirement, because it means that they cannot carry the same number of warheads that they can today.

So, just by making that step, what you really have achieved is an important percentage reduction in the first phase on the ground in the Soviet Union.

Senator WILSON. Mr. Chairman, my time has expired. I would just conclude with a comment.

I think that Secretary Costello's remarks this morning about the DAB process indicate that they have been very critical, but I think very fair, and it has produced dramatic results, along with the miniaturization that we have seen today.

Dr. COSTELLO. Thank you.

Chairman NUNN. Thank you, Senator Wilson.

I believe Mr. Kyl is next.

Representative KYL. Thank you.

First of all, General Abrahamson, let me repeat what so many others have said here. We are all expressing our appreciation to you for your service. You have directed this program now for almost 5 years, and you have meant a great deal to the security of this Nation as a result of that work.

You are the one person in this Nation who has been privy to all of the information that has been derived from the program, both from a technical point of view, as well as the policy aspects of it.

I would like to ask you, as probably the single most knowledgeable person in the country at this point about our strategic defense technology and capabilities, whether or not a layered strategic defense system, capable of achieving the program's originally stated goal, which you talked about in response to Senator Wilson's question a moment ago, is feasible?

General ABRAHAMSON. I am more convinced than ever that progress is so real that we are about to embark on a very dramatically different next phase.

The investments that we have made, both in the near-term—and you see some of these results—but also in the far-term systems are about ready to truly pay off at a rate that people will just be astounded with.

By the way, for that I again have to thank both the Congress and the people out there who have made this possible.

The answer is most assuredly yes.

Dr. COSTELLO. Congressman, I might add that at this point I think we have a broader consensus for the program throughout DOD than we have ever had before. I think this also is a verification of the validity of the program today.

Representative KYL. That ties right in to my next question, which relates to the rapidly evolving nature of this program. I want to ask General Herres a question.

In the March testimony before the Senate Armed Services Committee, you testified with General Abrahamson about the JCS requirements for Phase I, and at that time were unprepared to say whether or not the program was capable of achieving those JCS requirements.

You mentioned that it would be difficult to answer because the correct concept definition still had some variables in it.

I understand from your testimony today that the program has been defined, that you now believe that Phase I meets the goal of deterrence, that a layered system is suggested because of what it can add both in terms of survivability and deterrent value. And to you, the bottom line question is can you now definitely answer the question that, even as recently as last March, had some variables in it?

General HERRES. As well as I could answer that question about any program at this stage in its development cycle.

You must remember that we are at milestone one. We are just past milestone one. We have looked at a revised concept for milestone one. We are just past system concept definition.

What lies ahead is a fairly extensive phase, several years of concept demonstration and validation.

I would not be a good, dutiful member of the Defense Acquisition Board if I did not look ahead with some skepticism. We get promises from lots of program managers, lots of service acquisition executives, and we see successes, modest achievements, and so forth.

We have an incremental program formulation and development system and we are applying that system to this program. It will prove itself as it goes along.

But this program is well defined for this stage of its development, and we have every reason to have confidence that it can mature.

The technologies are there. You have seen them. I don't doubt that any of these technologies are important and are applicable.

The tough problem that lies ahead is pulling all that together and integrating it, weaponizing it, into a viable system that can be a credible deterrent.

There is no reason to think that we cannot do that.

Representative KYL. That is an important milestone, I think, for the joint committees here at this stage in the program, and also considering the fact that, obviously, we will be going into a new administration next year, and everybody in the country is going to be looking carefully at the program and the direction and needs some confidence, obviously, that it is important to move ahead.

I would like to ask a final question of all three of you, particularly General Abrahamson. It goes back to a question that Senator Wilson asked. I would like to put it in a slightly different context.

I view the cost effective at the margin requirements as boiling down, in effect, to three things. First of all, a program has to be effective, it has to have value. Second, you have to consider the cost of it. Third, you have to consider what it is going to take to protect it, both in terms of cost and ability.

It seems to me that, considering these three elements, what we have heard today is that the cost of SBI, the space-based interceptor part of the program has been significantly reduced through a variety of changes, the baseline cost at $17 billion; with respect to survivability, that most of these are issues that we cannot get into in a public session, but that you are confident of the survivability, particularly in the context of the time span as well as the other features that will be developed. Finally, we get to the question of

value, and that was really the question that Senator Wilson addressed.

I wonder if you would have any other comments to us about the value of the space-based component in a first phase development. Just how critical is that?

I know that skeptics of the program have pointed to all three of these issues as being problems. I think two are clearly solved, and it remains to demonstrate the value of this system, both to the congressional skeptics as well as the American public.

General ABRAHAMSON. I think, as a responsible program manager, we still have to achieve that. We have to put these together, as General Herres indicated, and demonstrate it.

But there is no question in my mind that, once done, this will be the most significant contributor to the deterrent posture of such a program. It is the completely new and different element, and it is one that the Soviet planners will just have to deal with.

In that sense, I think it is absolutely vital to a program, and I believe that is what the President expressed when he objected to having artificial constraints on one very promising portion of the technology.

However, it is important to recognize that there are other things that have to be put together. The real deterrent value will be when this system can operate together in such a way that the Soviets say there just is not an effective way to deal with it, and that the costs to try to counter it will be so high that it works into the third element of the President's vision, back in March 1983, and that is actually negotiated reductions, that it motivates those reductions. I think it is doing that now today.

And so, I think it is the total program. It is not merely one technology. It is the new strategy. It is the technology and the way they work together in a negotiation strategy that really gives it the value. And it is the remarkable vision that the President outlined for us.

Representative KYL. Thank you.

Representative SPRATT [presiding]. Senator Glenn.

Senator GLENN. Thank you, Mr. Chairman.

I have supported all the research money, as you know, General. You and I have talked about this many times. We have only had a disagreement on how fast we went into a deployment. That still concerns me, that we are starting into a Phase I deployment and may be spending an awful lot of money, cutting hardware, when maybe I still feel it is a little bit premature.

As you used to describe the program and as everyone at the Pentagon described it in earlier days, it was going to be the big shield. It really did not pay to go with any part of that system unless we could sometime see the whole system coming together.

Pursuant to that concern, I have made regular trips over the years—the last trip was about 10 months ago—out to the labs that are doing the work on this technology. When you talk to the scientists that are actually doing the work in the labs, they say the parts that were necessary you had on your first chart, the kinetic, the lasers, and the particle beam projection.

When you talk to the people doing the work on the lasers and the particle beam, they talk in terms of we may make a break-

through to the point it could be practical to be used in a system like this within 10 years, though more of them talk in terms of 15 years. Some will say we'll be lucky at 15 years, and it may be beyond that.

So we are really talking about making decisions for a system that would be a practical one, of even having the scientific breakthroughs out there in the future—take your choice on the expert you want to talk to—in 10 to 20 years.

And so, that is why I have had a concern about going to early deployment, because we may never get to that point and we are going to be spending an awful lot of money cutting hardware that I have felt, as you are aware, should be going into research.

I support everything you have done in basic research. It may come together sometime so that we really can put a shield like this together. But, along the way, we also get all the benefits out of the things that you were showing us here a little while ago, which I support fully—the microminiaturization, the computer technologies, the engines. All of these things have many other applications that I am very much for.

So I am your biggest supporter on the research but, I am a critic of the early deployment.

Would you respond to some of those concerns? I have also been concerned—if I may add one other thing—that we may be spending an awful lot of money cutting hardware and about the time we get some of this deployed, the threat is not going to be necessarily from ICBMs or from ballistic missiles. It is going to be from cruise missiles at 50 feet or 100 feet off the ground. That we can route them and get them into targets at supersonic speeds. The Soviets are doing a lot of work in that area, too. That is just another element.

Basically, as you see this now, when are we going to have the breakthroughs? What is your estimate on the breakthroughs in lasers and particle beams that would let us really have a viable, full system, not just a little part of it over here (indicating) that might be in its own way some little bit of deterrence, but is not really going to do the deterring job that the Soviets have so feared we might be able to deploy?

Dr. COSTELLO. Let me begin answering that, Senator. First of all, we have talked about milestone zero and milestone one, milestone one for six segments of the program. We will have more milestone one reviews with the DAB.

We look at deployment as a milestone three decision process. There is a lot of demonstration, validation, research and development, and verification that we're going to go through before we firm that up and decide that it is time for deployment. So we have nothing at milestone three now which we consider the deployment decision point.

The General can talk about some of the specifics as to the use of technologies, and what I call transparent upgrades, so that you can start with one basic technology and then take advantage of the new technologies as they are developed. Abe.

General ABRAHAMSON. Sir, I think the real problem here is in the perception that what we are talking about is an early deployment. Some have even gone so far as to say that it is a secret deployment plan, which is all nonsense.

You and I know that we have tried to be very straightforward, that in order to answer the questions about how effective will a system be, we have to be able to bring the research forward far enough so that people can have confidence in the answers.

That decision to go to even the development phase of a program is in the future. It is a milestone two decision, and it will be a very tough DAB that will be there and will, in fact, make that kind of thing happen.

If you will notice, most of the money that we are spending is at the component level, this miniaturization effort, so that it, in fact, can be affordable. That is the good news story that we are telling today.

If we were not making these several generations of hardware, it would only be a drawing on a viewgraph that I show you. Frankly, certainly you would not have confidence, but I would not have confidence and my successor would not have confidence in just a drawing on a viewgraph. I can assure you that this tough Defense Acquisition Board would not have confidence either.

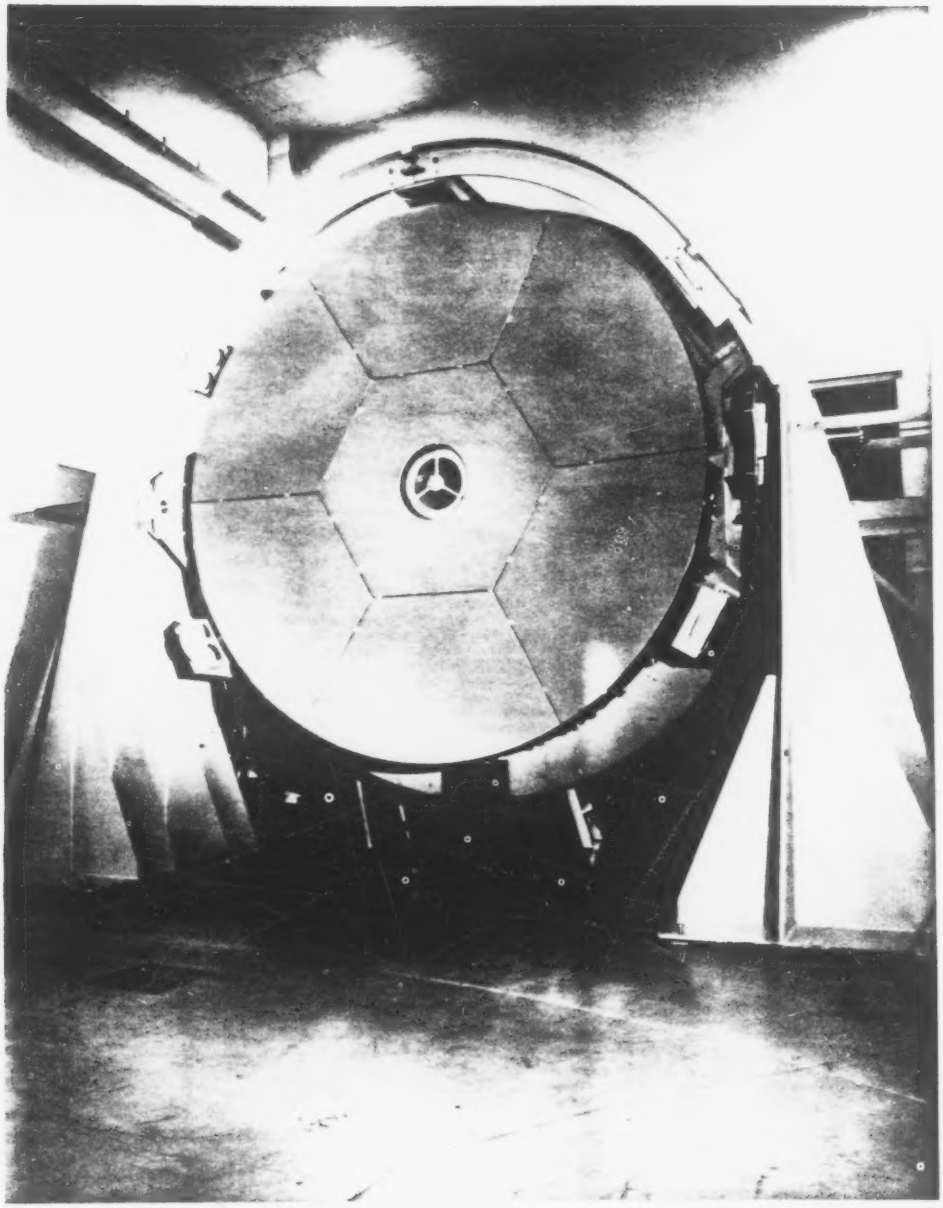
Now, the important issue that you are really raising is when that decision is made, can the other parts of it come along at a rapid rate. That gives me a wonderful opportunity because we have concentrated on Phase I, and that is happening as well.

Let me just show you a couple of those charts, sir, if I might.

We have talked about a space-based laser or a ground-based laser, and we are concentrating on affordability there in exactly the same way. We have to build big mirrors, huge mirrors, and we have now developed the automated system so that we can make those at a reasonable cost. I am not satisfied yet, but they are going to be very affordable in the timeframe.

So, even though we have not finished all the physics of some of these lasers, we are already working on the affordability portion of it. Otherwise, if it is not promising, as an affordable solution, we should not be spending all the money on the physics, which I think is very, very critical.

So that is part of this delicate balancing act that we have to bring forward.



Here is the completed LAMP mirror for a spaced based laser. And, by the way, this is in acceptance tests today. That is important—acceptance tests. That is the most sophisticated, largest mirror that one has. It will be available to mate to a laser, which is already in and has been for nearly a year, but we had a fire, unfortunately, which slowed it down, which is in a space chamber out in California, and in perhaps 6 months, we will be able to demonstrate the concept of chemical lasing in space.

Now that is really moving forward, in my judgment.

Dr. COSTELLO. I think one of the other aspects of the program that is key and allows us some confidence in where we are going is the fact that we are not just looking at product engineering. The General has stressed the ability of process engineering to support his activity. It does not do any good to have the design on the table if you can't make it. So we have been looking at how to make it and get that process activity emphasized to a level that it has not been in many of the programs. That is a major shift, I think, for the U.S. economy, to look at how to, as well as what to.

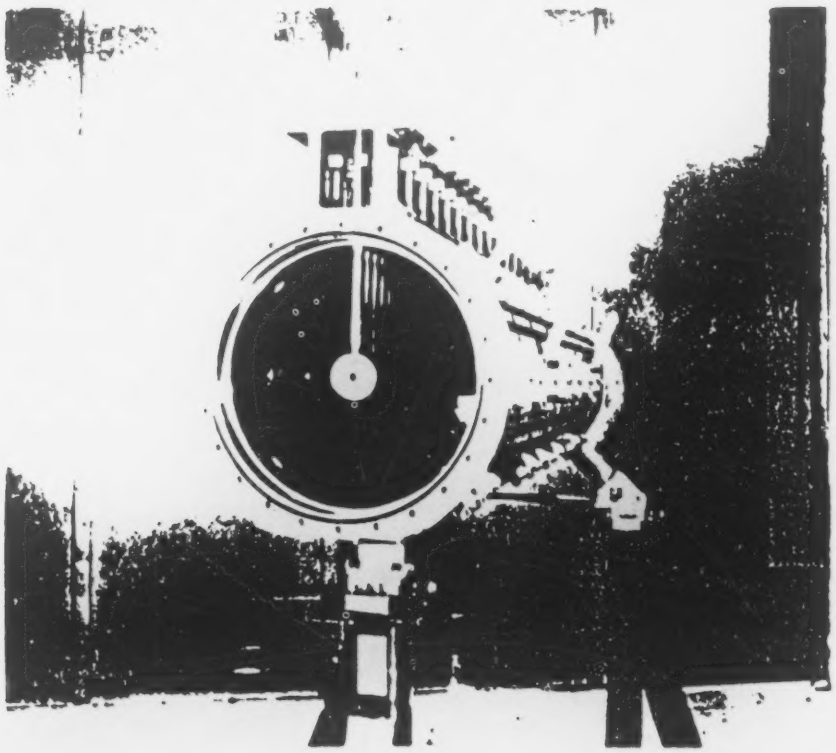
General ABRAHAMSON. Yes, we could use a neutral particle beam or some of the others, too.

Here is what is called a Drift Tube Linear accelerator (DTL). Senator, you have talked to those people.

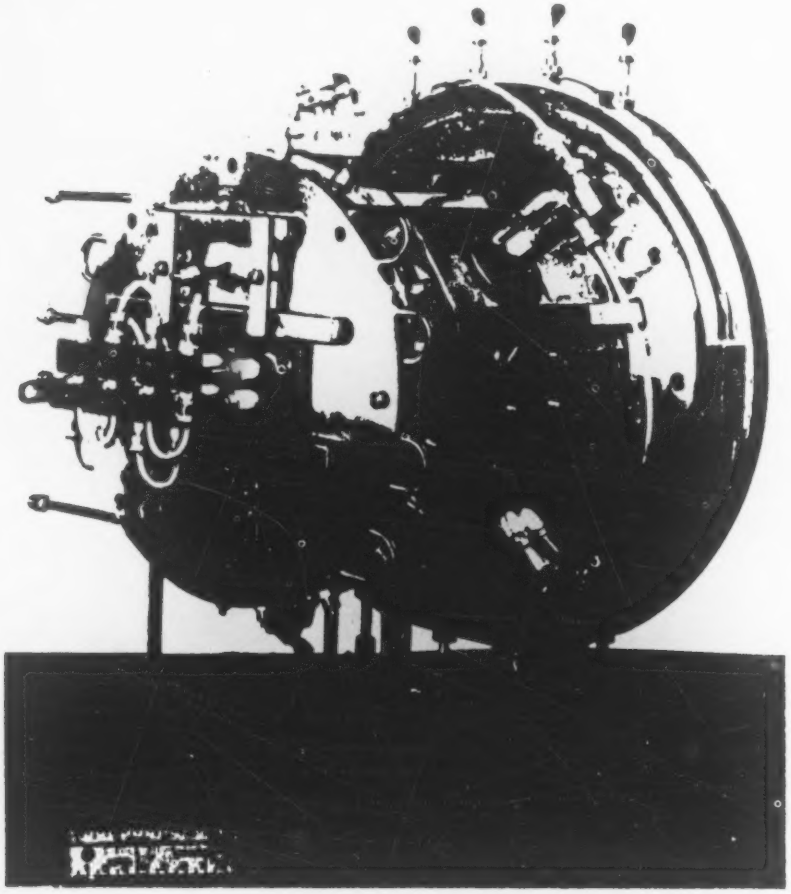
We have completed all the construction out at Los Alamos for a ground-based version of a neutral particle beam that will answer the final physics questions. Where are we in that program? We have developed each of the components to the level where we have great confidence that we can work, and one of them might even jump that level, and that has to do with some of the high temperature super conductivity applied to some of these concepts.

So we have done much of the component work. We have made the investment in facilities for testing on this particular concept.

RAMPED GRADIENT DTL



VOLUME SOURCE



Here is the volume source, one that the American Physical Society, when they examined the program a little over 2 years ago, said was going to be a very tough challenge. We have already achieved the level that we need for weapons.

[Chart deleted.]

Here is where we have established the first of what we call our models. It is a manufacturing and operation development laboratory. This is out at Oak Ridge, TN. It is finding ways that we bring together the community of people interested in optics and their developments in such a way that we can bring the costs down in this case for optical elements of a laser in the future. This is an innovative process management concept and technical concept, to try to bring those down.

I am not saying that we are there, not by any means. But your concern that we won't be far enough along with the second phase

of a system when we make the first phase development decision is a valid one. The control on that is what the Joint Chiefs and the acquisition process have put on.

Perhaps, General Herres, you would like to comment on that.

General HERRES. To do so, I would only reiterate what I have already said about the incremental aspect of the formulation stage, the program formulation stage. A lot of concept demonstration-validation lies ahead before a deployment decision, whether you call it early deployment or whatever, before a deployment decision is made. We are not making a deployment decision at milestone one by any stretch of the imagination.

Senator GLENN. My time has expired.

General, let me just wish you the very best. We have followed your career closely and personally ever since back in the NASA days. You have done an outstanding job. I will add my congratulations and best wishes to those that have already been expressed here.

Good luck to you.

General ABRAHAMSON. Thank you, Senator.

Representative SPRATT. Mr. Kasich.

Representative KASICH. Thank you, Mr. Chairman.

Abe, I want to direct a question to you and to the General.

I have been in Congress for 6 years and I have been following the debate on what we ought to do for defense. It seems as though we never have any clear direction as to where we want to go. Now, with SDI, we have people questioning technologically can we achieve certain things and if we can't, should we deploy? The President said he wanted a leak-proof shield. I think most people now agree that that is not something which can be achieved within any short period of time. But, at the same time, that is no reason not to pursue SDI.

So I take a look at where we have been on our entire policy of deterrence. You know, we wanted SDI to change the thinking from mutually assured destruction to mutually assured survival.

We're not going to shift the way that Soviet military planners look at things with any Phase I system, but let me advance something to you.

If we are going to use SDI as a way to confuse Soviet military planners—that is the argument that we used when we deployed the MX missile—we ought to go ahead and deploy, even if it is a vulnerable system. This system being advanced can also confuse Soviet military planners. So that starts to lead me down the path of thinking that this is another leg of our deterrent, that we have a sea-based, a land-based, an air-based, and now maybe a semi-space-based leg.

Why don't we try to find some common ground? A couple of years ago, as you know, I asked the SDIO to do a study on accidental launch. In fact, even before Senator Nunn had asked for that, I asked whether we could do a study on that.

I think most people in this room would agree that a Phase I system that is ground-based and kinetic in nature, can be very effective against, No. 1, accidental launch; No. 2, against a Third World ballistic missile threat; and, No. 3, could serve as a very effective point defense system.

Now we have gone through this debate about what are we going to do with MX and Midgetman. We say that we are going to put the MX in garages. The Democrats are basically opposed to it, the President is for it. They want to do Midgetman. Half of us don't know what we favor. All are designed to have a robust land-based missile program.

Why don't we forget an MX mobile system and take the $11 billion? Why don't we forget the Midgetman system and deploy a Phase I system in Grand Forks that would serve to protect our land-based force? We would eliminate the arguments and discussions over what kind of basing mode we ought to have.

We have been talking about basing modes for 20 years. We are not going to solve that problem. We don't have the $40 billion to do Midgetman and to do SDI. Why don't we think about not doing any more in the land-based force and coming together as a Congress, deploying the Phase I system in Grand Forks. It would protect us against accidental launch, would protect us against a Third World threat, and would protect our land-based missiles. You achieve everything all at once. You have the deterrence for the land-based force, you have Phase I in place, we have moved forward with SDI. We all agree that the technology is available today to do that. Then, if we develop follow-on technologies that can give us this Astrodome thing, fine. But we have utility, we have saved money by not pouring more money into land-based missiles, and we continue to preserve our strategic deterrence.

What would be wrong with a program along those lines?

General Herres, I would like to have you and General Abe comment on that please.

General HERRES. Let me begin by saying that we need to modernize our land-based strategic leg.

Representative KASICH. Let's presume the MX is a modernized land-based leg. Your problem is that it is vulnerable. If you put the system up there, it is not as vulnerable and would still confuse the Soviet planners.

But let's remember that MX is a modern leg. I hope you still define it that way.

General HERRES. I was about ready to say that that is what MX is all about, among some other things, or is partially about.

It is also about making the land-based leg more survivable. I do not accept the idea that it is more vulnerable. It does provide a significant deterrent in garrison. It can launch under attack. It will depend, like other legs of the triad on warning, of course, to be effective.

It is a very effective deterrent against a much more likely scenario, and that is the contemplation of a surprise attack during a crisis or confrontation.

We can increase the survivability of our strategic offensive forces within a matter of hours with the Rail Garrison MX system.

What I would suggest is at best a slight variation on what you have suggested as an alternative. It would be the Rail Garrison MX with the Phase I and ultimately the objective strategic defense system. I think there can develop a synergism between those elements of the strategic force structure, albeit one is offensive and one is defensive.

You add to deterrence against the "bolt out of the blue," so to speak, which is very, very unlikely, or the day-to-day unprovoked surprise attack with a Phase I system. You add other capabilities that offensive systems do not add. For example, you do have a way of dealing with the concern about an accidental launch.

More importantly, you are providing a very significant hedge against what may develop to be a very serious threat, and that is non-Soviet nuclear missile proliferation of the future.

So the limited protection system, the accidental launch protection system, both are spin-offs of the objective system and of the Phase I deployment. They are immediate spin-offs of the Phase I deployment.

Furthermore, by proceeding with the development of the SDI Phase I system, you have provided a very significant and a very important hedge against sudden Soviet breakout and sudden Soviet deployment of a strategic defense system, which, as I have said here many times before, can be done by the Soviets much more quickly because they are willing to use nuclear warheads in their missiles.

I would suggest that that is the best and the most economic approach to a well-balanced deterrent force structure.

Representative KASICH. When you say $40 billion on the Midgetman program that you don't necessarily need at that point, take the $40 billion from there and use it to run your SDI program.

General HERRES. Well, the Midgetman will provide a lot of deterrence—I'm not going to argue that—the Small ICBM, if we could deploy it and we could actually utilize it in a mode that is contemplated, and if we could afford it. But the operations and maintenance costs of that kind of system, the security of that kind of system in its constantly mobile situation are going to be very, very expensive.

This is a much more reasonable approach to that problem.

Representative KASICH. Thank you, Mr. Chairman.

Chairman NUNN [presiding]. Thank you very much.

Senator Levin.

Senator LEVIN. Thank you, Mr. Chairman.

I want to welcome all of our panelists today.

First, General Herres, would the deployment of this new Phase I system require withdrawal from the ABM Treaty under either interpretation of the treaty?

General HERRES. Yes, sir, it would.

Senator LEVIN. General Herres, are you in a position now to recommend that we deploy this Phase I as soon as possible, as soon as it is deployable?

General HERRES. No, sir.

That is what the concept demonstration-validation phase is going to be all about, to demonstrate that these technologies are mature enough to be weaponized, that this system will perform as advertised and as expected, and that the costs that will have to be expended to field the system are reasonable and absorbable.

Senator LEVIN. When will you be in a position to recommend whether or not to deploy this as soon as it is deployable?

General HERRES. At the end of the concept demonstration-validation phase, which, depending on what kind of funding levels evolve

and the progress of the program, will be in probably the early to mid-1990s. There will be time for a decision to go to full-scale development. That will be another incremental decision. It will be a bigger decision. One does not need to make a deployment decision at that point.

But, clearly, there will be some development actions that will be expensive and that you probably would not want to pursue unless you were fairly convinced you wanted to deploy. But you still could keep your options open at that point.

Really, when you get to milestone three, when the production decision is made, then you definitely have to be committed by that time.

Chairman NUNN. When would that be, milestone three?

General HERRES. I would have to defer to Jim on that.

General ABRAHAMSON. Actually, it will depend on each of the systems.

What we have done is we have brought the BSTS satellite forward because it has other military requirements.

Milestone two for that will be somewhere in the 1990–1991 timeframe, assuming the funding and the technical progress for one to go ahead.

If that really were successful, then a milestone three would be somewhere in the approximately 1994 kind of timeframe, or the 1993 timeframe.

Chairman NUNN. Don't take this out of Senator Levin's time. I am hearing two different answers here.

General HERRES. What Jim is saying is correct, sir.

General ABRAHAMSON. That's only for one part of the system, sir.

General HERRES. Yes. He's talking about a different element of the system——

General ABRAHAMSON. That's right.

General HERRES [continuing]. Where you started the discussion about deployment of the phases. Actually, there would be several milestone three decisions. But when you get to the weapons part of it, you are talking about a decision much further downstream.

What Jim has just talked about is something we need to do whether we proceed with Phase I or not, the warning system part of this.

Dr. COSTELLO. The BSTS has early warning capabilities that we need in place. So you could say we'll put it up to do early warning. And that is why we said it is really a system of systems. We will look at each of these as they come on the calendar, what progress has been made technically, as well as the decision to finally deploy at some later date.

Chairman NUNN. I'm sorry to interrupt you, and don't take that out of Senator Levin's time, please.

Senator LEVIN. That is all right.

General Herres, if the Soviets were to deploy a Phase I system, like we have seen outlined here today, would we be able to counter it?

General HERRES. I couldn't give you a very complete answer to that question in this forum, Senator Levin.

You know, no system is ever going to be a panacea or a system for all times and indefinitely. We are going to have to stay abreast

of Soviet defensive technology. I doubt that, in the lifetimes of the systems we are deploying right now or have deployed, the Soviets could field a system like this.

Senator LEVIN. Would you be inclined to recommend that we take out such a Soviet system if they unilaterally deployed it, that we acquire the capability to eliminate that Soviet defense system if, in fact, they unilaterally deployed it? Wouldn't we want to have that capability?

General HERRES. We would need to build capabilities to contend with it. Yes, sir, there is no question about that.

Senator LEVIN. One of you testified relative to the cost estimates here that CAIG has made these estimates. The Cost Analysis Improvement Group you say has endorsed your $75 billion to $150 billion cost estimate for the original Phase I system. Are you sure of that, whoever said that?

General ABRAHAMSON. Yes.

Dr. COSTELLO. I indicated that the CAIG used the same process on the $115 billion estimate as they used to come up with the $69 billion figure.

Senator LEVIN. Would you get us both their estimates? Would you provide that for the record?

Dr. COSTELLO. It would probably be classified.

Senator LEVIN. One way or another, would you provide both the CAIG estimates on the original Phase I and the new Phase I?

Dr. COSTELLO. We'll provide that for you. Yes.

[The information referred to follows:]

CAIG REVIEWS OF COST ESTIMATES FOR STRATEGIC DEFENSE SYSTEM, PHASE I

This paper describes the work of the Cost Analysis Improvement Group (CAIG) in the Office of the Secretary of Defense (OSD), on two cost estimates for Phase I of the Strategic Defense System. The estimates are the ones that supported the in-progress reviews (IPRs) of that program that the Defense Acquisition Board (DAB) made on June 2, 1988 and on October 4, 1988. The Secretary of Defense previously provided this material to Senator Weicker in response to a request he made.

INTRODUCTION

Both in the spring and in the fall, estimates provided to the CAIG for review were based on Cost Analysis Requirements Documents (CARDs) agreed to by the services and SDIO. These documents set out the main technical characteristics, schedules, and deployment plans of the systems to be costed, and contained important assumptions on schedule and the availability of key technologies.

The system described in the CARDs had six component programs: the Boost Surveillance and Tracking System (BSTS), the Space Surveillance and Tracking System (SSTS), the Space-Based Interceptor (SBI), the Ground-Based Surveillance and Tracking System (GSTS), the Exoatmospheric Reentry Vehicle Intercept System (ERIS), and Battle Management/Command, Communications and Control (BM/C3). In the fall, SDIO defined a new category of BM/C3 functions, which they called Command and Control/System Operation and Integration Function (CC/SOIF). A seventh program, the Ground-Based Radar, is under consideration for Phase I, and its costs were also reviewed. Costs of launching the space-based segments were reviewed as a separate category.

In preparation for both the June and October DAB reviews, cost estimates for BSTS, SSTS, and SBI were prepared by military and civilian personnel of the Air Force Systems Command's Space Division; these people also estimated the costs of launching the system's space-based segments. Personnel of the Army's Strategic Defense Command made cost estimates for GSTS, GBR, and ERIS. The SDIO used contractor support to generate estimates for BM/C3 in the spring and CC/SOIF in the fall, and for supplementary briefings on costs of System Engineering and Integration, and of the National Test Bed. Services' cost teams were not assigned the task of evaluating the assumptions in the CARDs: they costed the systems as defined by

those assumptions. The estimates were briefed to the CAIG, generally in 2-hour meetings, as described in the attachment.

In both the spring and the fall, the results of the CAIG's analyses were briefed first to the Strategic Systems Committee (SSC), and then to the DAB.

CAIG REVIEW FOR THE DAB MEETING ON JUNE 2, 1988

The total acquisition costs for SDS—Phase I briefed to the CAIG was $118 billion (FY 1988 dollars), with costs for the Advanced Launch System (ALS) excluded. (Concluding that certain elements of BM/C3 had been counted twice, the SDIO later reduced the total estimate, excluding ALS, to $115 billion.)

The CAIG presented a comparison of estimated budget requirements of the component programs (as described in the underlying CARDs) with resources programmed in the services' and SDIO POMs. On the basis of this display, and discussion presented by SDIO of possible program adjustments, the CAIG concluded that the program as it stood in May/June 1988 very probably could not be excluded within POM resources. This was the CAIG's main conclusion.

The CAIG also discussed two sources of uncertainty common to all cost estimates, as they applied to the estimates in hand. These sources are: uncertainties inherent in the art of cost estimation, which affect the ability to cost the system specified; and uncertainties that arise from the possibility that the system actually built will differ from the one specified.

In most cases the estimates presented to the CAIG contained responsible discussions of uncertainties inherent in the estimating process itself. Production estimates sometimes contained adjustments for "business as it should be," reflecting the degree to which advances in producibility and production technology could be expected to reduce manufacturing costs. The CAIG concluded that achieving the "business as it should be" figures, while not impossible, represented great challenges. Accordingly, in the CAIG's opinion, the total estimate for SDS—Phase I was a somewhat optimistic estimate of the cost of the specific configuration that SDIO presented to the cost teams in the CARDs.

[Deleted.]

CAIG REVIEW FOR THE DAB MEETING OF OCTOBER 4, 1988

The briefing noted that cost estimates for the restructured SDS—Phase I program were dramatically lower than the cost estimates for the program briefed to the DAB in June 1988 ($115 billion in June versus $69 billion in October), and pointed out that nearly three-quarters of the reduction was accounted for by reductions in the estimated costs of SBI. Estimates for Command and Control, and for SSTS, also were reduced significantly.

The reduction in the SBI estimate was due primarily to changes in the number of SBI's procured, and to changes in the SBI's configuration. SDIO achieved more than half of the SBI reduction by cutting the interceptor quantities. The remaining change came chiefly from removing the fire control and battle management functions from the carrier vehicle, and from reductions in the cost of the interceptor vehicle stemming from the replacement of a scanning focal plane array in the sensor with a staring array. Only a minor part of the reduction came from changes in cost estimating methods and assumptions.

In contrast to the spring, the CAIG found that, with the exception of launch costs, the estimated requirements of the program were funded within fiscal guidance, over the period of the five-year defense plan. Estimates for launch costs remain under development and review.

Estimating methods for the restructured system being the same as those used for the predecessor system, the CAIGs earlier comments on those methods still applied. In particular, the CAIG found that the assumption of benefits from "business as it should be" remained an area of cost-estimating uncertainty for many of the estimates.

As in the spring, the CAIG thought that a significant source of cost risk, which is difficult to qualify, is the possibility that the system presently specified would not be the one actually built.

The CAIG noted that there are reasons for both optimism and pessimism about the SDS—Phase I estimates. On the one hand the extensive cost estimation and review processes applied to SDS—Phase I, the long Demonstration/Validation program, and a substantial technology development/risk reduction program with clearly identified targets, all are grounds for optimism. On the other hand, assumptions about the availability of technology and about schedules are optimistic, and achieving the "business as should be" assumptions in production will be a demanding challenge.

To summarize the principal conclusions of the CAIGs fall review:

The changes in cost estimates from June to October were due almost entirely to readily identifiable changes in the component programs. Only a minor part of the reduction was due to changes in cost estimating methods and assumptions. This is the CAIGs main conclusion.

The estimated requirements of the component programs were funded within fiscal guidance, over the period of the five-year defense program.

Achieving the "business as it should be" assumptions for production costs remained a significant challenge, and schedules remained optimistic.

Cost briefings to the OSD CAIG in support of Defense Acquisition Board Reviews of Strategic Defense System—Phase I

Briefings in support of spring review:

ERIS/GBR/BM/C3	March 31, 1988
SEI/National Test Bed	April 2, 1988
GSTS	April 4, 1988
BSTS	April 26, 1988
SSTS	April 28, 1988
SBI	May 9, 1988
Wrap-up	May 23, 1988

Briefings in support of fall review:

GSTS/ERIS/GBR	August 18, 1988
BSTS	August 26, 1988
CC/SOIF/SEI	September 2, 1988
SSTS	September 8, 1988
SBI	September 16, 1988
Launch	September 19, 1988

Senator LEVIN. Dr. Costello, while you are answering questions, I think almost a year ago or more you indicated that there had yet not been an official definition of the term "other physical principles," which is so important, if we are to know what we are able to do under even a narrow interpretation of the ABM Treaty.

Is there now an official definition of "other physical principles?"

Dr. COSTELLO. There is still not an official definition.

Senator LEVIN. You thought that might be forthcoming fairly soon, that somebody in the State Department had to make that decision. Is that still in the State Department?

Dr. COSTELLO. Yes, it is.

Senator LEVIN. Judge Sofaer still has not made the decision?

Dr. COSTELLO. He is still the individual who is to come up with that answer.

Senator LEVIN. Do we know what year we will be getting that?

Dr. COSTELLO. One needs patience, sir.

Senator LEVIN. My question is how many more years?

Dr. COSTELLO. I can't answer that, but I hope it is not going to be "more years."

Senator LEVIN. My time is up.

Thank you.

Chairman NUNN. Thank you, Senator Levin.

Senator Shelby.

Senator SHELBY. Thank you, Mr. Chairman.

General Abrahamson, since you are considering reducing the size of much of the SDI hardware, what effect, if any, will that have on the advanced launch system? Will it eliminate the need for it?

Would you like to comment on that?

General ABRAHAMSON. We are in a dilemma on the advanced launch system, sir. The advanced launch system is something that

the Nation needs. The program was put together as something that is not only for SDI but is, in fact, for NASA needs in the future, for other military needs, or, frankly, anybody. It is part of our being a truly capable and space-faring nation.

The program is put together in such a way that, hopefully, some of the benefits will accrue not only to an advanced launch system but to some of our existing launch systems.

It is a technology investment where we can improve both reliability and cost. Some of those things will be applicable to existing systems. But in the end, the large benefit for real low cost and reliability will come when you can put together this modular approach.

"Modular" is something I would like to emphasize. You will be able to start with a small capability and assemble these things together to tailor them to the size of the launch requirement that you have to deal with. That is going to be a pretty large investment over a significant period of time.

Last year, in the emergency supplemental, the Congress put a restriction on our ability to invest in this partial or incremental approach to that. I would urge you to reconsider that, not for SDI purposes or SDI purposes alone, but also for the issue that you can make part of the investment, and if you can then deploy part of those systems for any of the national requirements, even if it is incremental, if the modules are ready, you can begin to get a payback—a payback in reliable launching and a payback in reduced costs.

Therefore, I would really urge you to do that.

We have in this cost estimate assured that the advanced launch system will not be ready on time, and that is because there is a large amount of funding that has to be there, and we have costed alternative concepts.

The best approach is to proceed with this modular approach to the advanced launch system and be able to have a part of it ready, so that the Nation can use it.

Senator SHELBY. General, we have discussed this before and you have elaborated on it some today, what I would call the multi-purpose use not only of the Air Force or military but of NASA's use for ALS.

What about the cooperation that is going on with NASA and the Air Force on ALS? Do you think that is a good idea?

General ABRAHAMSON. Oh, yes.

Not only do I think it is a good idea; I think it is working. It is working.

There are still some differences, of course, in how fast you can get there and what are some of those. You always have that kind of issue.

But let me tell you, that program office, which is a joint program office in the Air Force, is relying on the NASA capability in propulsion, but supporting it with the Air Force capability in propulsion. The NASA people, who are working on the cost savings that can eventually come about for the rest of the vehicle in the launch concept are relying on the Air Force experience in that. But they are also contributing their own.

I think it is very successful.

Senator SHELBY. But NASA has had tremendous experience in propulsion, particularly at Marshall, haven't they?

General ABRAHAMSON. Yes, they have.

Senator SHELBY. Secretary Costello.

Dr. COSTELLO. Senator Shelby, I chaired a DAB on the ALS in which NASA participated. I think there is, again, good communication, and we are looking at and structuring our resources together in this program. We have some tough decisions to make as it is not a cheap program.

We certainly cannot penalize a program like the SDI to pay the whole way because it is a broad-scope program, as the General describes, a national asset at which we have to be looking.

Senator SHELBY. General Herres.

General HERRES. Senator, I would like to add one thought to your original question with regard to the utility of ALS to SDI.

The major purpose of the ALS program, as stated in our JCS Mission Need Statement for the advanced launch system is to provide a vehicle or a family of vehicles which will reduce our cost to put payloads in orbit by a factor of 10 or perhaps better. Very clearly, the impact on this program, as on other space programs, is going to be very significant.

So it is important, not just from the standpoint of heavy lift, but it is important, even more so, from the standpoint of getting launch costs down, so that programs like this can be more achievable.

Senator SHELBY. And by cooperating between NASA and the Air Force, with the knowledge that both have, that should bring the cost down. Should it not, General Abrahamson?

General ABRAHAMSON. I have great confidence that that team together can do so.

Senator SHELBY. Is the advanced launch system underfunded at this time?

Dr. COSTELLO. Yes.

Senator SHELBY. By how much?

Dr. COSTELLO. We're not sure what the total projected cost is for the advanced launch system at this time. I think we have a lot of scrubbing to do on that program. We have the same opportunities on that program to reduce costs that General Abrahamson has shown you today, and we have to get those things into perspective before we can come in here and lay it on the table.

Senator SHELBY. General Abrahamson, did you want to add anything?

General ABRAHAMSON. I agree. I think that there is a very challenging technical program. But there is also a challenging funding allocation that has to be achieved, and it has not been yet.

Senator SHELBY. Would you say that the advanced launch system is a high priority?

General ABRAHAMSON. Absolutely, sir.

Senator SHELBY. Thank you.

Thank you, Mr. Chairman.

Chairman NUNN. Thank you, Senator Shelby.

I guess we will go now to a second round. I think everyone has had one round.

General Herres, we were talking a little while ago with Senator Warner about the ABM Treaty. What is the Joint Chiefs' current position on the question of whether the United States should continue to adhere to the ABM Treaty?

General HERRES. Our view is that we should continue to abide by the ABM Treaty until it is clear when we should withdraw and for what purpose we should withdraw.

Chairman NUNN. Do you have any projection about when we will reach that time phase within the Joint Chiefs?

General HERRES. No, sir.

We are working along the lines that we described earlier. The only reason on the horizon for withdrawing from the ABM Treaty that we see would be the anticipation, actually a deployment decision for Phase I.

Chairman NUNN. I'm sorry, I didn't get that.

General HERRES. A deployment decision for Phase I would be the only reason that we would see on the horizon.

Chairman NUNN. All right.

When do you think a deployment decision will need to be made on Phase I, earliest it could be made, based on your own personal assessment? What is the timeframe?

General HERRES. I will have to shoot in the dark. You may have been gone when we were talking about this earlier with some earlier questions.

There will be some deployment decisions for treaty compliant elements of the system, and I'm not really talking about those. But when you get down to the deployment of the weapons themselves, beyond those limitations of the treaty itself, I think you are talking about the mid-1990s. But I would have to defer to General Abrahamson, who has a better handle on how fast those things can develop.

He would like to have the date earlier, of course, because he would like to see rapid development progress. But I think we are talking about the mid-1990s.

Chairman NUNN. Let me shift to another area.

You mentioned in your opening statement that the Phase I system, I believe, without trying to quote you directly, was the minimum requirement needed to cross the threshold in terms of adding to deterrence.

General HERRES. Deterrence of the Soviet threat.

Chairman NUNN. Deterrence of the Soviet threat. And you are now talking about the complete deployment of the Phase I system when you say that?

General HERRES. Yes, sir.

Chairman NUNN. What is the earliest you believe, based on your knowledge of the program, that we can anticipate a complete deployment of the Phase I system?

General HERRES. I think we are looking at just after the turn of the century.

Chairman NUNN. So that will be the first point in time that you believe we will have contributed to deterrence with this program?

General HERRES. We'll cross that threshold during that deployment phase.

Now, it is not a very precise point in time because, again, this is a judgment call. When we make a deployment decision and we begin deployment and we begin building the level of deterrence, we will cross that threshold when we meet the capabilities to meet the Phase I requirement.

Chairman NUNN. Right.

General HERRES. If I might add one thing, we do deter other things. I want you to keep in mind that the other spinoffs that I talked about earlier still exist on a lower level, at a lower level of deployment.

Chairman NUNN. Right.

General HERRES. But when we get to the Soviet attack, the Soviet nuclear attack level of deterrence, that is the threshold that I am talking about.

Chairman NUNN. In your assumptions about deterrence and Phase I and so forth, do you have an assumption that the Soviet Union will or will not deploy some system of their own? By this I mean some rough equivalent to Phase I? I am not trying to compare technology here, but are we going to be facing an adversary, in your assumptions, that has a system deployed in space, or will we be basically facing one that stays on the ground?

What are your assumptions there?

General HERRES. We are assuming that, when it becomes clear to the Soviets that we will deploy, that they will expand their defensive capabilities in one form or another.

Chairman NUNN. Are you making assumptions now about survivability of the critical leading elements we talked about a little while ago, if that happens?

General HERRES. We are having to assume that we can build systems that can survive. We know we are not going to build anything that is immortal. But we will have a balance of robustness and capabilities that can thwart the kinds of threats that might materialize. Those considerations are there.

Chairman NUNN. That survivability element against a Soviet adversary with their own systems up there, is that programmed into the present charts we have seen on Phase I?

General HERRES. Yes, sir.

Chairman NUNN. In survivability?

General HERRES. Yes, sir.

Of course, as in all our systems, survivability is a thing that grows. As you know, you don't just put survivability in and turn the switch on.

Chairman NUNN. It's action/reaction?

General HERRES. That's exactly right.

Chairman NUNN. The assumptions become pretty crucial as to what you are assuming will be done on the other side, do they not?

General HERRES. Yes, sir.

Chairman NUNN. Are you satisfied that those assumptions from the Joint Chiefs point of view have been fully plugged into this Phase I now?

General HERRES. We will continue to scrub them and examine them. But I think that they are being worked as best as anyone's vision about what the Soviet capabilities for that time period can be.

Chairman NUNN. General, let me return to the point Senator Levin developed a little while ago. I think you said you will have to answer a lot of questions when somebody, let's say General Abrahamson's successor, comes over and says "Well, I believe now that this system, Phase I, is deployable in the year 2000." When you get to that point, what other questions will the Joint Chiefs be asking beyond simply the question of whether the system is "deployable?"

General HERRES. Well, the question, deployable, begs many questions. What we will do, what I expect is that at each stage we will review the requirement against the performance that has been demonstrated to that point in development. At the end of the concept development, our concept validation phase, we need to review the requirement and compare it with what is achievable at that point. Again, when that full-scale development decision is made and full-scale development is pursued, we will want to review the requirement again and match it with the capabilities of the system that is under development.

I am sure we will see lots of improvements in capability and we will see some places where our expectations may have been a little bit too high. But that is going to have to be a continuous process.

Chairman NUNN. So there are a lot of other things that you have to decide, then, beyond simply that something is capable of being put up in space?

General HERRES. Oh, yes, sir. Whether it will perform will be our principal——

Chairman NUNN. Whether it will perform, and it's survivability?

General HERRES. That is part of the performance.

Chairman NUNN. Survivability and cost effectiveness at the margin?

General HERRES. Yes, sir.

Now, cost effectiveness, if it becomes too large a burden, a disproportionate burden in the strategic force structure, we will call attention to that.

Basically, the DAB is going to work the cost effectiveness aspect to that. I will participate in that process. But from the standpoint of comparing what the system can do and what it should be able to do, we will be working that under the JCS umbrella with the Joint Requirements Oversight Council.

Chairman NUNN. In other words, if General Abrahamson's successor came in and said to the Joint Chiefs one day, gentlemen, it is deployable, that would not give you a green light, right?

General HERRES. Not at all, sir.

He is going to have to go through the series of reviews that I discussed.

Chairman NUNN. How about you, Mr. Costello? If they came in one day and said it is deployable, do you say three cheers and here we go, off on it?

Dr. COSTELLO. No. That's why General Herres and I work so well together. We both have the same ideas.

Chairman NUNN. You will have a lot of questions to ask at that stage before you would recommend to the President that it be deployed?

Dr. COSTELLO. Absolutely.

Chairman NUNN. Thank you.

General ABRAHAMSON. Senator, may I just add one thing to that, please.

Chairman NUNN. My time has run out, so I will have to ask the indulgence of my colleagues.

Representative SPRATT. I think we are all inclined to indulge our chairman.

Chairman NUNN. Thank you.

General ABRAHAMSON. It isn't just assumptions on survivability, sir. It is real progress, which is reviewable. Of course that is what both Dr. Costello and General Herres were talking about.

Here are a series of samples that we have subject to high energy laser tests on the assumption that the Soviets might attack a space-based element a little bit at a time, through lasers. There are also a set of samples of materials that we have tested at nuclear radiation levels that exceed what we might expect by a very substantial amount.

So I guess I would like to get across that there is a very important survivability program that is real.

Chairman NUNN. That is very much a part of the program?

General ABRAHAMSON. Yes, sir.

Chairman NUNN. Thank you. I believe that is very important.

Mr. Spratt.

Representative SPRATT. Thank you, Mr. Chairman.

Let me put a hypothetical to you that I don't think is too unrealistic.

Suppose as you approach milestone three the directed energy systems are not ready. They are simply not mature enough. Propagation problems have not been worked out. Adaptive optics are still a problem. Whatever the problem may be, they simply are not at a stage where a reliable judgment can be made as to whether or not they will ever reach fruition as a weaponizable system.

Do you go forward then, or do you wait on the lasers? And, if you have real doubts about the lasers, do you go forward just with Phase I and forego Phase II? Is it worth it?

General HERRES. Those are considerations that will have to be brought to bear on the problem. Remember, though, that we probably won't know what the answers to those questions are when we have to make a Phase I deployment choice.

In other words, that Phase I deployment choice will be made when the laser, when the directed energy weapons systems, are still in an earlier stage of development.

Representative SPRATT. As I understand what the JCS has said, however, you have said that we want to be reliably informed at that point that the directed energy systems can come to fruition. We are not going to proceed with Phase I in the dark as to Phase II.

General HERRES. What we have said is that the Phase I requirement is not an objective system. It is the first increment.

Now, where you go beyond Phase I is yet to be determined.

We will develop a Phase II requirement next year.

Now, what you are really asking me is this: is the directed energy weapon absolutely essential to the objective system, and it is not clear yet that it is absolutely essential to the objective

system. We might find that it is at some point in the future. But there are other options for gaining a lot of leverage.

General Abrahamson described one, which is popularly known now as Brilliant Pebbles, or "Smart Rocks," or whatever.

But there are lots of other options besides the directed energy weapon. It's a very important thing to do, the directed energy weapon, and we expect the highest possible leverage with that kind of technology. But I am not prepared to tell you at this point that the directed energy weapon is the sine qua non of the entire system.

Representative SPRATT. Well, I had always thought it was the coup de grace if not the sine qua non. [Laughter.]

General HERRES. It may very well be, and we hope so.

Dr. COSTELLO. I think, Mr. Congressman, if we only had one option, we would have a very tentative system at this point in time. If that were the only way we could go, we would not be as confident as we are that we have options that will allow us some flexibility.

General ABRAHAMSON. Yes, sir. I think there is a kind of ground rule that has been established that was discussed and in the context of the acquisition process. This is prior to the time that you begin a development on Phase I, that first system, that you have at least brought the next phase far enough forward that a milestone one type of decision is established, which gives you that confidence, that level.

Obviously, you can extrapolate that a step further and say you probably would not want to begin the deployment of that Phase I system until you had progressed quite substantially further than that for the next follow-on.

By the way, that is one of the reasons that it is an expensive program, because you have to bring forward those options. But it is not merely what our own technical development is, sir.

I believe that we have to have the ability to watch what is happening on the other side as well, and to see, with the benefit of several years of watching their testing, their strategy, and what they are doing overall, in terms of both deterrence and threatening posture.

Representative SPRATT. I don't have much time, so let me flip the hypothetical.

Let's assume that as you approach milestone three for Phase I, the laser systems are coming along nicely. Indeed, they are on track for deployment by 2005 or somewhere along in there, as you indicated, General Abrahamson. And they are proving to be unusually effective and lethal. Is it not true that, if they are effective for a boost phase intercept, they will certainly also be effective for ASAT missions as well? If that is correct, don't we have a problem in deploying Phase I in year X and then in year X-plus-5, deploying a system that would be the most lethal countermeasure to Phase I, namely the ground-based or space-based laser systems with ASAT capability?

General ABRAHAMSON. The first and most important thing is that we would not shoot at our own satellites, of course.

Representative SPRATT. I am assuming that if we can bring the AFLs along and we have been warned in countless intelligence

briefings that the Soviets are robustly pursuing the same objectives, they will be coming along as well.

General ABRAHAMSON. I think that is an important issue that you brought up. Let me just be philosphical, if I might.

One of the failures of strategic theory at this point, in my judgment—and now I am offering you judgment not as a research and development officer, but as one who certainly has been plunged into this process—is that when we get to the level of strategic theory, very often it is described in those stark black and white terms. It is "you destroy all of theirs and they destroy all of yours." "If you can do it, they can do it."

By the way, that is not the criteria that the Department of Defense or the Congress applies when they look at a new airplane, when they look at a new tank or a new ship. Therefore, I think the real issue will be determined in the graze. And, by the way, that is why deterrence and a different approach to deterrence is so vital.

I have spent a lot of time thinking through how wars really start. The fundamental assumption, if you go back to the first of the nuclear strategists, Herman Kahn in "On Nuclear War," the fundamental assumption right in chapter one is that the adversaries on both sides are going to be absolutely logical, that they are going to do a clear cost benefit analysis in every one of these things. If you begin to look in that literature, I think you will find just how brittle that assumption truly is.

In this regard, I would like to recommend one of these books that really does deal with how wars really start, and they are not that simple, cold calculation.

Now, the nuclear era is a slightly different era. But it deserves that kind of thoughtful examination.

Representative SPRATT. May I submit one thing for the record?

We have asked questions about the projected FYDP wedge for SDI and yet were not able to provide anything.

We have been provided with some data by your organization. I know it is tentative. If we could, we would submit that for the record. If it is classified, you can put it into a classified annex. At least you can tell us if this is within the approximate range of what you expect to be budgeting.

Chairman NUNN. Without objection, that will be part of the record.

[The information referred to is included in the questions for the record.]

Chairman NUNN. I think Senator Warner had questions for the record and I have a few, so, without objection, we will submit those. We will try not to burden you with very many. We are going over them to make sure that we eliminate duplications.

Mr. Kasich.

Representative KASICH. Thank you, Mr. Chairman.

Let me ask you, General, there is a line of questioning here that I think was taking us down the path to assuming that until you have a completed SDI program, anything less than a completed SDI program offers us no utility when it comes to the question of deterrence.

Now, when we look at an MX, if Scowcroft recommends 100 and we only put two in the ground, does that then mean that we don't

have any deterrence until we have 100 in the ground? Or have we actually enhanced deterrence when we have two in the ground, or when we phase in an SDI program? Do we begin to get any utility as we begin to phase that kind of program in?

I think that there is at least an implication that until you have the whole thing in, it does not have much utility.

General HERRES. Let me reemphasize that and make sure I am clear on your point because it is a little bit of a delicate point.

The Phase I requirement is what we have—it is strictly a judgment call—it is what we have judged to be the threshold at which you provide some significant amount of deterrence. It is the minimum amount of deterrence, really. "Significant" is the wrong term. Depending on where you are coming from, the "minimum" is "significant" in some people's minds.

But the point is in our judgment, if you field a system with a lesser capability than what the Phase I system could provide, you are not likely—not likely, and no one knows the answer to this question for sure—you are not likely to significantly alter the planning, the thinking, in the mind of a Soviet planner about the success of his attack, given the size of his force structure and the things he might have to do with that force structure.

Now, again, the other side of what I said is that the Phase I system is the least militarily significant capability; but it is not the capability that we would desire. If we thought that the program would stop with the Phase I capability, we would not be supporting it, and our requirement makes that clear.

Dr. COSTELLO. I think, Mr. Congressman, also you do get utility out of some of the sub-systems, or as we call it, the system of systems.

The BSTS would be very useful in early warning. So that element alone would have significant value to us, and I think you work your way through a system of that type. And, yes, you can get value for the system, but not looking at the specifics of the requirements that have been set down by the Joint Chiefs.

General HERRES. I would like to stress a point that General Abrahamson made earlier because it is a very good one. Do not compare the whole cost of Phase I to this concept that I am discussing. It is only fair, really, to discuss the weapons part, the missiles, the interceptors, the ERIS, the space-based interceptors, because the other elements in the system, in part the command and control system to some degree, and the surveillance and warning elements of the Phase I system, they make contributions to deterrence by bolstering our offensive credibility as well as the defensive credibility.

Representative KASICH. One final question. I have to run to a vote.

Abe, let me ask you this.

Richard Perle was in the other morning and we asked him about the narrow-broad interpretation. He says if we stay within the narrow interpretation of the treaty, we might as well shut the program down because it is going to have very little utility in being able to achieve most of our really big goals.

Would you agree with that?

I have read the ABM Treaty. I have tried to read what experts have said. I have tried to understand, and I get hung up on "other physical principles" as well as you probably do. That says something to me that it does not say to others.

But the bottom line is Perle says that if we don't make it broad, we may as well forget it. He believes there should be a broad interpretation of that treaty. I wonder what your view is in terms of that argument.

Dr. COSTELLO. I'll start and then the General can also add his comments.

The key is, going back to some of the statements in the DSB report to which the chairman referred, everything is not black and white. It is too simplistic for it to be called black and white.

We are going to make a lot of progress and we have not breached the narrow interpretation of the treaty to date. We can continue to make progress.

At some time you are going to have to say that is no longer valid, we will pull out of the treaty, and we will deploy or we will do something else. We do not have to make that decision today because we are not there yet. It may be costing us money, and we said we would come back during the next fiscal year's budget work and look at that.

So we will work our way through it. But to stop it today because we don't have a broad interpretation of the treaty would also be very wrong.

Chairman NUNN. I think you will find when you dig into it very deeply that if the people who were so intent on moving to the broad had not made the narrow overly restrictive in order to sell the broad, you would be less impacted than you otherwise will be.

There has been a real game going on in the Pentagon now by some people. I am not saying who. I don't know. They try to make the broad compelling by making the narrow unbearable.

If we end up with the President deciding that he will continue the traditional interpretation, then those people themselves have brought about some real harm to the overall SDI program by being more restrictive than the original treaty envisioned, I think, traditionally.

Dr. COSTELLO. I think Secretary Carlucci has stated where we are. We testified last spring where we are, and I think that is the road that you are expecting us to follow. We are going down that path.

Chairman NUNN. I think that is the right path. I think you are proceeding correctly on it and I am delighted that you are. We all have to assess this as we get to the points of decision and have to be sure that we are receiving accurate information. We also have to have integrity in our legal views in deciding whether we shift to the broad or whether we, indeed, decide that our own national security demands that we give 6 months notice, in an honorable way, under international law.

I mean, it is not true that the only way we can go is by reinterpreting the treaty. There is another way that was visualized by those people who negotiated and by President Nixon, who signed the ABM Treaty, and that is 6 months notice. There are honorable ways in international law and there are other ways.

I think we have more than one choice here.

Senator Levin.

Senator LEVIN. Thank you, Mr. Chairman.

Of course, the withdrawal clause in the ABM Treaty is a supreme national interest clause, which would have to be cited for the decision to withdraw.

Relative to the ABM Treaty, Dr. Costello, I asked you before whether you had received a definition of "other physical principles." I just want to press that question a bit further.

Don't you need that definition before it is possible to make any judgment as to what savings, if any, could be achieved under a broad interpretation? Don't you have to know the meaning of that phrase and what experiments or testing would be permitted under such an interpretation?

Dr. COSTELLO. I'm going to have to walk around an answer perhaps. Yes, we do need to finally determine what "other physical principles" are. But there are many things we can do that do not require that specific definition today.

Senator LEVIN. But my question is it has been alleged that you can save some money if you move to a broad interpretation. What I am saying is how much you could save could depend upon what the definition is of "other physical principles." Is that not true?

Dr. COSTELLO. That is true. Yes.

Senator LEVIN. So we would need the definition before we get your estimate.

Chairman NUNN. He didn't answer that. Let's see if he agrees with you, because I agree with Senator Levin. I don't see how in the world you can answer that because, if "other physical principles" means one thing, then it doesn't matter whether you have the broad or narrow interpretation. You have the same impediments either way. So you cannot possibly compare the broad versus narrow costs until you know what the govenmental position is on "other physical principles."

That was not a statement but a question.

Senator LEVIN. Do you agree with that? Do you agree with our chairman?

Dr. COSTELLO. Everybody else agrees with your chairman, why can't I? [Laughter.]

Senator LEVIN. I would urge you to. [Laughter.]

Do you agree that you have to really know that definition before you can estimate savings?

Dr. COSTELLO. To get the greatest flexibility in what we are doing and to get the best answers for you, yes.

Senator LEVIN. The Defense Science Board, back in April 1987, said that there has to be an analysis of a two-sided SDI, with our having it or their having it, before we can really proceed.

They said that such an analysis had not then been done. Has it been done, a two-sided analysis?

General HERRES. I think I understand your question. Do you mean an analysis of say at some point in time what our strategic force structure and their strategic force structure are?

Senator LEVIN. Let me read you their unclassified statement.

"At the same time, the requirements process should be broadened to include an analysis of the desirability of deployment, which includes a consideration of a two-sided BMD or SDI deployment."

Then it says, "It is clear that such an analysis has not been satisfactorily done."

My question is has such an analysis been completed?

General HERRES. I don't think it has been done in the context your question is being asked, or that is referred to there.

We are certainly constantly analyzing what we think the Soviets' ballistic missile defense capabilities might be.

Senator LEVIN. And, as you have indicated, you have made certain assumptions and you have, as you put it, I think, laid out certain criteria for the survivability of our SDI?

General HERRES. Well, we are constantly doing that now.

The requirement is nonspecific with respect to techniques and with respect to the threat. It simply says that the system must be able to survive.

Our process will be to do an annual threat analysis and threat projection.

Senator LEVIN. But in reference to the chairman's questions, I believe you said that you have made certain assumptions relative to the survivability of our Phase I.

General HERRES. We are making assumptions about what we think the threat could be and then what we can do to deal with that threat and in analyzing those and seeing how much that threat can degrade the performance of the system.

Senator LEVIN. I understand.

You have made assumptions both, then, as to the survivability of our system and as to what Soviet defenses would be?

General HERRES. I'm nervous about the word "assumptions." You know, Abe followed up my answer with some good thoughts, too.

We are trying to make projections as much as assumptions. We have to make assumptions where we don't have enough information. But we would like to know a lot about Soviet ballistic missile defense capabilities and their technology.

Senator LEVIN. Fair enough.

In your presentation of a new Phase I, you have then made certain projections of Soviet capability, both to defeat our Phase I SDI, and you have also made certain projections as to what Soviet defenses would be like. Is that correct?

General HERRES. That's right.

Senator LEVIN. Would you supply for the record those projections?

General HERRES. Well, we'll have to get some pretty high classification, I think. That could be a problem.

Senator LEVIN. Whatever the classification is, would you provide those projections for the record in classified form. I have just one other question and am about to run out of time. So would you do that? Can you do that for the classified record?

General HERRES. We will do the best we can in that regard. It is going to have to be, you know—we'll do the best we can and try to explain it and see how well that meets your needs.

[The information referred to follows:]

The projections used in the evaluation of the new Phase I Strategic Defense System (SDS) were extracted from the Defense Intelligence Agency (DIA) Strategic Defense Initiative Program Systems Threat Assessment Report (STAR), dated 30 September 1987. For the October 1988 Defense Acquisition Board review, the base year agreed to for use in evaluating the architecture was [deleted]. Further analysis will be done when the Joint Staff has a full-up two-sided strategic force analysis capability. [Deleted.] Acquiring this analytic capability in the next year will enable the Joint Staff to conduct analysis in more detail and provide additional insights. [Deleted] the Joint Staff has tasked DIA to provide a representative, responsive threat that specifically includes a Soviet response to Phase I deployment at the time of its full operational capability. Phase I SDS requirements and performance will be reviewed and evaluated in light of this updated threat projection.

Senator LEVIN. My final question is this. You have all testified that it makes no sense to decide now to deploy Phase I of SDI as soon as possible because there are too many unknowns. You have said under no stretch of the imagination.

General HERRES. There are uncertainties. Yes, sir.

Senator LEVIN. And those uncertainties will not be clarified until the early 1990s or the mid-1990s.

General HERRES. Well, time won't clarify them. Activity will clarify them—the demonstration-validation phase, which should mature in that timeframe.

Senator LEVIN. In that timeframe.

General HERRES. Yes, sir.

Senator LEVIN. So they may be clarified in that timeframe.

Your honest caution on that issue is very well taken, that we be very cautious as to whether we want to deploy Phase I as soon as it is deployable because there are too many unknowns, like the cost benefit, like whether it meets the Nitze criteria. There are a number of unknowns in there. Your caution is in sharp contrast to the Vice President's position, which is—and I am quoting from his debate—"I will deploy it when it is deployable."

General HERRES. I don't see any contradiction there—"when its deployable."

Senator LEVIN. You don't see any contradiction? I asked you point blank this morning are you recommending we deploy it as soon as it is deployable and you said no, no, there are too many unknowns.

General HERRES. Now, wait. Senator, when you said that, I qualified the word "deployable." I said implicit in the term "deployable" are lots of things one has to know——

Senator LEVIN. You didn't say that.

General HERRES [continuing]. And "deployable" means different things to different people.

Senator LEVIN. You did not say "implicit in the term 'deployable.'" You said under no stretch of the imagination, and Dr. Costello said absolutely I would not recommend now that we deploy Phase I when it is deployable, and then both of you went on to say why you would not.

I am just simply saying there is a very clear contrast to the stated position of Vice President Bush, trying to draw this very clear picture, when he says I will deploy it as soon as it is deployable.

That is all I am saying.

General HERRES. And I disagree.

Senator LEVIN. You can say he didn't mean to say that or implicit——

General HERRES. No, sir. No, sir.

What I am saying is that the term "deployable" can clearly embody the criteria that one has to apply to determine whether or not the system can, in fact, meet its cost and performance projections. One can decide that that term "deployable" embodies that concept.

Chairman NUNN. So it really depends.

General HERRES. I believe I qualified that term very briefly. But what I meant with my qualification was it depends on what you mean by "deployable." If it is simply a matter of being able to go out and put it in place and nothing more, nothing beyond that, then I would say no. When the program manager comes in and says yes, I can deploy this system, we have all these other questions about deployability to ask.

Senator LEVIN. So, it depends on the definition of "deployable."

General HERRES. Exactly.

Senator LEVIN. So you can't say that you would deploy it as soon as it is deployable unless you know what is meant by the word "deployable."

General HERRES. Exactly.

Chairman NUNN. I think the General made very clear what he believes needs to be examined once someone says that it is deployable, and he went into the cost effectiveness, the feasibility, the survivability, all of those things. You would have to determine whether someone intended that word to include those or exclude those. I think Mr. Costello said the same thing.

So the question really is once somebody tells you that it is deployable, what do they mean by that, right?

General HERRES. Yes, sir. Exactly.

Senator LEVIN. General Abrahamson, let me also recognize your stalwart service and contribution. I think all of us feel that you have made a very, very strong and loyal and positive contribution, and we want to recognize that here.

General ABRAHAMSON. Senator, thank you.

Chairman NUNN. General, what is your retirement date? We may be seeing you again. We may be saying goodbye more than once. [Laughter.]

General ABRAHAMSON. My date is January 31, sir.

Chairman NUNN. January 31, well, we may be back here in time to bid you farewell again.

Thank you for being here, Dr. Costello, General Herres, General Abrahamson. Thank you all for a very good hearing. We appreciate it.

[Questions for the record with answers supplied follow:]

QUESTIONS SUBMITTED BY SENATOR STROM THURMOND

SPACE LAUNCH COSTS

Senator THURMOND. General Abrahamson, space launch costs have frequently been cited as a cost driver in the SDI program. What changes have been made in the estimates of space launch costs in the restructured program, and what are the assumptions underlying the current estimates?

General ABRAHAMSON. Space launch costs are an important, but not dominant, element of the cost estimate for Phase I of the Strategic Defense System. Our launch plans have changed to adapt to the changes in acquisition plans for the Advanced Launch System and will be further refined upon completion of an in-depth study in the coming fiscal year.

The changes in assumed launch vehicle allocations for cost estimating purposes follows:

	June 1988	October 1988
BSTS	Titan IV/Centaur	Titan IV/Centaur.
SSTS	Titan IV	Atlas II.
SBI	ALS	SBI Dedicated.

The SBI Dedicated vehicle is planned to be a derivative of an existing strategic missile. Current cost estimates assume that the Peacekeeper propulsion section will be the basis for this booster, expanded and fit with less complex nozzle and guidance equipment in keeping with the less rigorous mission of launch versus weapon delivery.

We believe that we have allocated sufficient funds in our acquisition cost estimate to accommodate this requirement.

SURVIVABILITY

Senator THURMOND. Survivability and discrimination have been among the most important challenges facing the space-based segment of the SDI program. What can you say in this unclassified forum about the restructured programs ability to provide for survivability and target discrimination?

General ABRAHAMSON. From the beginning SDIO has incorporated a multifaceted and balanced approach to achieving necessary discrimination and survivability. Passive hardening and active spoofing technologies, as well as tactical and operational techniques, have and are being evaluated and developed in conjunction with element performance to operate effectively under a severe defense suppression attack. Measures such as nuclear and laser protection shields, decoys and other deception methods, maneuvering and dispersal tactics, and anti-jamming techniques are some of the key enhancements which are part of the survivability suite for the restructured architecture. The net combination of the space-based sensors, the probe, and the ground-based radar, provides effective discrimination capability. While all the operational issues have not been fully resolved, our analyses have shown that even if the attacker expends an unreasonably large number of ASAT resources, to negate a small percentage of our resources, the defense system can satisfy the JCS requirements. We believe we are well on the way to developing the necessary technologies and approaches that when combined correctly will assure mission success.

RESTRUCTURING

Senator THURMOND. Dr. Costello, in your statement, you indicate that as a result of the restructuring, you have "balanced the research program within our planned funding." Can you provide us with an indication of the level of funding the Congress can expect for this program over the next 5 years?

Dr. COSTELLO. The specific level of funding will be provided with the fiscal year 1990 Defense budget that will include a profile for the next 5 years. The priority of this program has not changed so you can be assured that we will be asking for substantial growth in the program throughout the 5-year period.

Senator THURMOND. Dr. Costello outlined Secretary Carlucci's guidance for restructuring the program that included continued research on space defense, early deployment of space based sensors, maintaining a deployment option for a limited protection system and a balanced longer-term weapons technology program. In your judgment, does the restructured program adequately address each of these areas? Do fund testing, or other limitations result in one or more of the areas being more likely to achieve success than the others?

General ABRAHAMSON. While the current program structure fully satisfies the program guidance, certain limitations do preclude the optimum pace of research. Funding has been constrained by the Congress. Our budget requests have been cut an average of 30 percent since fiscal year 1985. Such reductions serve to constrain in two ways. First, by simple reduction in total funds the research cannot proceed at

a pace which is permissible by the technology. Second, as individual projects are restructured to accommodate the reduced funding levels a substantial level of turbulence results, goals are delayed, and the total costs of individual projects increase. However, even with these limitations, we have been able to maintain a program which is properly balanced between near and far term technology, and between technology and systems research.

PHASE I ARCHITECTURE

Senator THURMOND. General Herres, in addition to reaffirming the military requirement for the Phase I architecture, what has been the role of the Joint Chiefs in developing or reviewing the restructured program?

General HERRES. As with any defense program, the Joint Chiefs of Staff have sought to represent the needs of the combat commanders. Since establishing operational requirements for the first phase of a multiphase ballistic missile defense system, the Joint Chiefs of Staff have been actively involved in the development and review of the program through periodic briefings by the Director, Strategic Defense Initiative Organization. Additionally, the Joint Staff has been a key participant in the defense acquisition process which has involved Defense Acquisition Board reviews of the Strategic Defense Initiative Program in June 1987, June 1988, and October 1988. Further, the Joint Staff is continuously conducting reviews of the threat, the requirements, and the system's ability to meet the requirements, and will continue to do so.

OFFENSE AND DEFENSE RELATIONSHIPS

Senator THURMOND. General Herres, over the past 5½ years, there has been much debate about the relationship of offenses and defenses. Like certain attributes of offensive forces, defenses have the attribute of enhancing deterrence by denying an attacker the certainty of success. However, effective defenses, unlike offenses, have the certain ability to limit damage and to save lives should deterrence fail. Do you agree with this assessment?

General HERRES. Yes, certainly defenses, unlike offenses, have the capability to limit damage and save lives. However, our policy of flexible response and deterrence through the threat of offensive retaliation has preserved the security of the United States and its allies for decades.

In pursuit of the capabilities needed to maintain and improve the U.S. deterrent posture, the Joint Chiefs of Staff believe that possession of ballistic missile defenses could enable the United States to fundamentally change its strategic assumptions regarding deterrence, permitting a shift of emphasis from strictly offensive to a more balanced offensive and defensive orientation. Effective defenses against ballistic missiles could significantly increase Soviet uncertainties regarding a given ballistic missile weapon's ability to penetrate and destroy United States and allied targets. Difficulties in predicting vulnerability and outcome could make Soviet military planners much less likely to contemplate initiating a ballistic missile attack, even in crisis circumstances.

EVERETT REPORT

Senator THURMOND. Dr. Costello, the Defense Science Board in the so-called Everett report, made certain recommendations about the phasing of the program, and you indicated in your testimony that the Secretary has adopted the stepped approach recommended by the DSB. Could you indicate more specifically the details of this stepped approach, and what positive features you see in the approach from the standpoint of acquisition management?

Dr. COSTELLO. The stepped approach directed by the Secretary of Defense begins with the development and deployment of space surveillance sensors. The BSTS is the first of these as it is required for the TW/AA mission. It is followed by SSTS. The next step could potentially be a decision to deploy a Limited Protection System or to initiate deployment of the ground-based elements of SDS. The full SDS Phase I is available next followed by subsequent phases. The stepped approach has the advantages of providing critical systems to fulfill existing requirements first followed by defense deployments. While we would like to be able to move more quickly to deployment of SDS Phase I, funding constraints simply do not permit the approach we were pursuing 1½ years ago.

RESTRUCTURED PROGRAM

Senator THURMOND. Dr. Costello, are you prepared to say at this point whether the restructured program can be pursued with confidence to the next major acquisition milestone, full scale development, within the so-called narrow interpretation of the ABM Treaty?

Dr. COSTELLO. The degree of confidence in the performance and technical feasibility of the Phase I SDS deployment would be less under the narrow interpretation. There is no question that the broad interpretation would permit tests that would increase our confidence. In my view we could probably proceed to full scale development in either case. We will have to make these decisions as we proceed into full scale development with full support to the Congress.

PHASE I COST REDUCTIONS

Senator THURMOND. General Abrahamson, is there one enabling technology, or one technological achievement that accounts for the substantial cost reduction in the restructured Phase I architecture?

General ABRAHAMSON. The substantial cost reduction from Spring 1988 to Fall 1988 in the acquisition cost of the SDS Phase I is due to a combination of events: the identification and elimination of redundancies, elimination of excess performance, decreasing space weapons, increasing ground weapons, the application of design realism instead of design conservatism through functional reallocation, and finally, the incorporation of recently available simplifying technology.

SPACE-BASED INTERCEPTOR SEGMENT

Senator THURMOND. Is it your judgment that the space-based interceptor segment is an essential element of the restructured Phase I architecture, and why is this the case?

General ABRAHAMSON. Absolutely, the space-based interceptor is an essential element of a Phase I Strategic Defense System. In order to provide an effective defense a multi-layered (space- and ground-based) system of interceptors is necessary. The space-based interceptors are critical as they can effectively reach offensive missiles in the boost and post-boost phases of an attack.

PHASE I COST ESTIMATES

Senator THURMOND. Dr. Costello, what is the basis for your confidence in the cost estimates that have been developed for the restructured program?

Dr. COSTELLO. The cost estimates used for the current estimates of the Phase I SDS acquisition costs were developed by SDIO and the services using the best available cost models. The Cost Analysis Improvement Group conducted an independent review of these costs and compared the costs to the available programmed funding. These cost estimates were made with the same models and techniques, and using the same procedures as the earlier Phase I estimated at the higher level. As a result I have complete confidence that the relative reductions in architecture cost are accurate to within the uncertainty of our cost models. Obviously some uncertainty does exist with regard to absolute costs developed by these models which are based largely on historical experience and extrapolations on the development of new technologies.

QUESTIONS SUBMITTED BY SENATOR JOHN MCCAIN

SDI PROGRAM

Senator MCCAIN. A great deal of the discussion of the U.S. SDI program ignores the size and pace of its Soviet equivalent. Could you provide a comparison of the size and structure of the United States and Soviet RDT&E effort in each major area of strategic defense and a comparison of the relative progress in each major area and of its cost in dollar terms?

General ABRAHAMSON. Unfortunately, while the United States strategic defense research is an open program, that of the Soviets is not. However, we can state, as General Secretary Gorbachev has, that the Soviet Union is pursuing research in all the areas being addressed by the United States SDI program. This effort has been ongoing for two decades and includes work on laser weapons costing about $1 billion per year. We estimate, as documented in the 1988 edition of "Soviet Military Power," the Soviet Union has spent roughly $20 billion per year on all forms of

strategic defense during the past decade, significantly more than the United States has spent. In the area of high-energy lasers, the Soviet research program has historically been much larger than its United States counterpart and involves the development of several lasers for strategic applications such as air defense or a terminal ABM and at least one laser believed capable of an antisatellite mission. Since the late 1960s, the Soviets have explored the use of particle beam and kinetic energy weapons for antisatellite and ballistic missile defense missions, and they have also conducted research in the use of radio-frequency weapons to interfere with or destroy the electronic components of ballistic missile warheads or satellites. Additional details may be found on pages 145–146 of "Soviet Military Power" cited above.

PROGRAM COMPARISONS

Senator McCain. Could you provide a detailed and comprehensive comparison of how the pace and structure of Soviet ABM and ATBM deployments and modernization compare with the efforts of the United States and with an estimate of the recent trends in investment and procurement in dollar cost terms?

General Abrahamson. Again, a detailed and comprehensive comparison of Soviet and United States ABM and ATBM efforts is not available. Nevertheless, we have been following Soviet progress in this area very carefully. The Soviets maintain the world's only operational ABM system. Moreover, a nearly completed construction program begun during the 1980s will yield an expanded and upgraded system comprising a two-layer defense provided by 100 launchers. When fully operational around 1989, this system will defend selected leadership and strategic facilities in the Moscow area. The new system will include a long-range modified Galosh missile intended to engage reentry vehicles outside the atmosphere, and the Gazelle, a shorter-range, high-acceleration missile that, like the defunct U.S. Sprint system is designed to engage RVs after they enter the atmosphere. New hardened silos have been constructed for these missiles. An integral part of the upgraded system is the Pill Box engagement radar located at Pushkino near Moscow. The other major element of the Soviet ABM system is a network of large phased-array radars (LPARs) which provide early warning ballistic missile detection coverage for almost all of the Soviet landmass. The Soviets began building these radars in the 1970s, and there are now nine in varying stages of completion, including the one at Krasnoyarsk which the United States believes constitutes a violation of the ABM Treaty. We believe this network will not be operational until the mid-1990s.

SBI PERFORMANCE AND SURVIVABILITY

Senator McCain. I am concerned that we may be following the path of our ABM program in stripping away the size and capability of our space-based systems in Phase I in a form that may produce savings, and look good on paper, but which will eventually prove too vulnerable and too lacking in capability to be credible.

The issues involved are very complex, but could you summarize the risks you see in cutting back on the scale of the Space-Based Interceptor and space-based effort, and provide a comprehensive and detailed risk analysis for each element of change in classified and unclassified form?

General Abrahamson. The refinements which have occurred in the Phase I Strategic Defense System are a combination of improvements in Space-Based Interceptor (SBI) performance and survivability, and changes in the mix of space and ground-based sensors, weapons, and battle management configurations. The layered defense architecture retains a robustness not found in previous ground-based systems. The design can accommodate refinements and improvements over time in the mix of systems, individual element performance, and system operation and tactics. Such refinements and improvements would respond to evolution of the threat and our own technology in order to maintain the necessary system performance.

For the SBI, the improvements in interceptor performance can be accepted with relatively little technical risk. Technical data on propulsion, battery lifetime, and sensor acquisition ranges fully support the interceptor performance predictions. However, because the present ABM Treaty precludes testing of an integrated interceptor, our performance predictions may not provide the confidence required by decisionmakers for a deployment decision.

Our analyses support the mix of space- and ground-based systems; sufficient numbers of both space- and ground-based weapons exist so that the offense must regard them with sufficient capability to preclude the offense from achieving it's objective. Survivability projections are fully supported by simulations which incorporate the refined SDS architecture, improved technical performance, and improved operation-

al tactics. In battle management, the sensor mix presents certain unknowns associated with correlating data from widely separated platforms. However, major activities are in progress to define the limits on such data correlation, and we will use the National Test Bed (NTB), as an evaluation tool for optimization and further improvement and refinement in the weapon and sensor mix. Such detailed assessments will be available as the NTB becomes operational as part of the research program.

COST ESTIMATION UNCERTAINTIES

Senator McCain. I appreciate the amount of detail you have already provided us with on how you have reached your new cost estimates. At the same time, we have seen RAND studies that indicate that the average real cost of complex system which are costed at this stage of development are 2½ times higher than the current kind of cost estimates indicate.

Could you comment on the uncertainty in your cost estimates and methodology for Phase I, and provide a detailed parametric cost analysis for the record, identifying major cost risks, the range of costs for each key element, the methodologies used for cost analysis and the range of uncertainty to Sigma 1 and Sigma 2.

General Abrahamson. Without any doubt, uncertainty in the cost estimation process does exist. We believe, however, that we have captured this uncertainty in our current estimates. The Phase I SDS cost estimates are based on the current (September 1988) design, technical and program information. A combination of cost estimating techniques such as engineering methods, analogy, or the use of parametric Cost Estimating Relationships (CERs) were used. The estimates which resulted represent the current Strategic Defense Initiative (SDI) Organization cost position and incorporate approved Army and Air Force estimates for their respective elements.

Technical baselines were established by the performing organizations (the services) using a standard data gathering format known as the Cost Analysis Requirement Document (CARD). The CARD consists of the following sections: Element Description, Element Interfaces, Element Operational Concept, Quantity Matrix, Element Manpower Requirements, Element Schedule, Element Research and Development (R&D) Phasing Plan, and Element Facilities Requirements.

The resulting $69.1 billion system baseline estimate represents the acquisition cost of the Phase I, incorporating cost risk.

Assuming a triangular distribution of the estimate values, and using a Monte Carlo simulation technique, we obtain the following range of values:

Fiscal Year 1988

	Billions
Acquisition cost	$69.1
1-Sigma range	63.9–74.3
2-Sigma range	58.7–79.5

We are preparing a full report on the costing process which we expect to release soon, and will be happy to brief any member on this process.

Questions Submitted by Representative Spratt

SDI BUDGET GROWTH

Representative Spratt. It is my understanding that the SDI budget is scheduled to grow by about 22 percent per year over the next 5 years. If this is true, the budget would reach $11 billion by the last year of the next 5 year plan (fiscal years 1990–1994). Is this approximately correct?

General Abrahamson. We are currently compiling the fiscal year 1990 budget and it is considered premature to attempt to forecast budget projections at this time. However, one of our objectives is that the SDI budget requirements remain within fiscal guidelines from which the Defense budget is established. The Defense Acquisition Board meets periodically to review the SDI budget requirements and conformity with budget guidance.

PHASE I SHARE OF SDI BUDGET

Representative Spratt. Last year the Phase I share of the SDI budget was 40 percent. What will that share be in fiscal year 1989?

General ABRAHAMSON. The allocation in fiscal year 1988 was further refined to separately account for technology that was related to both Phase I and any follow-on phases. With that accounting, the portion of the SDI budget unique to Phase I in fiscal year 1988 was approximately one-fourth. For fiscal year 1989 we estimate that share to remain roughly the same.

[Whereupon, at 12:40 p.m., the committees adjourned.]

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